

October 2020

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AIAA LA-LV Space Architecture Gathering (22 August, 2020)

by Prof. Madhu Thangavelu (Faculty Member, USC / ISU, Chair / Moderator of the Panel/Event), and Prof. Olga Bannova (Director, SICSA, College of Engineering, University of Houston, Chair, AIAA Space Architecture Technical Committee (SATC))

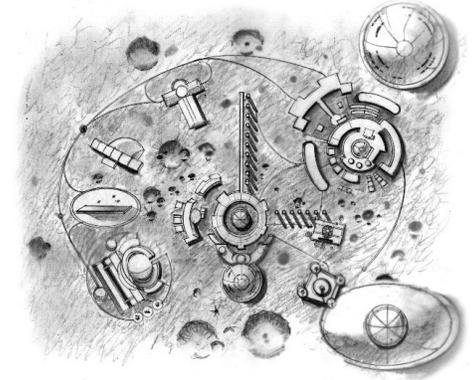
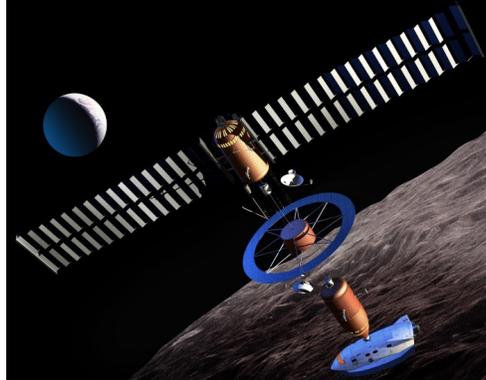


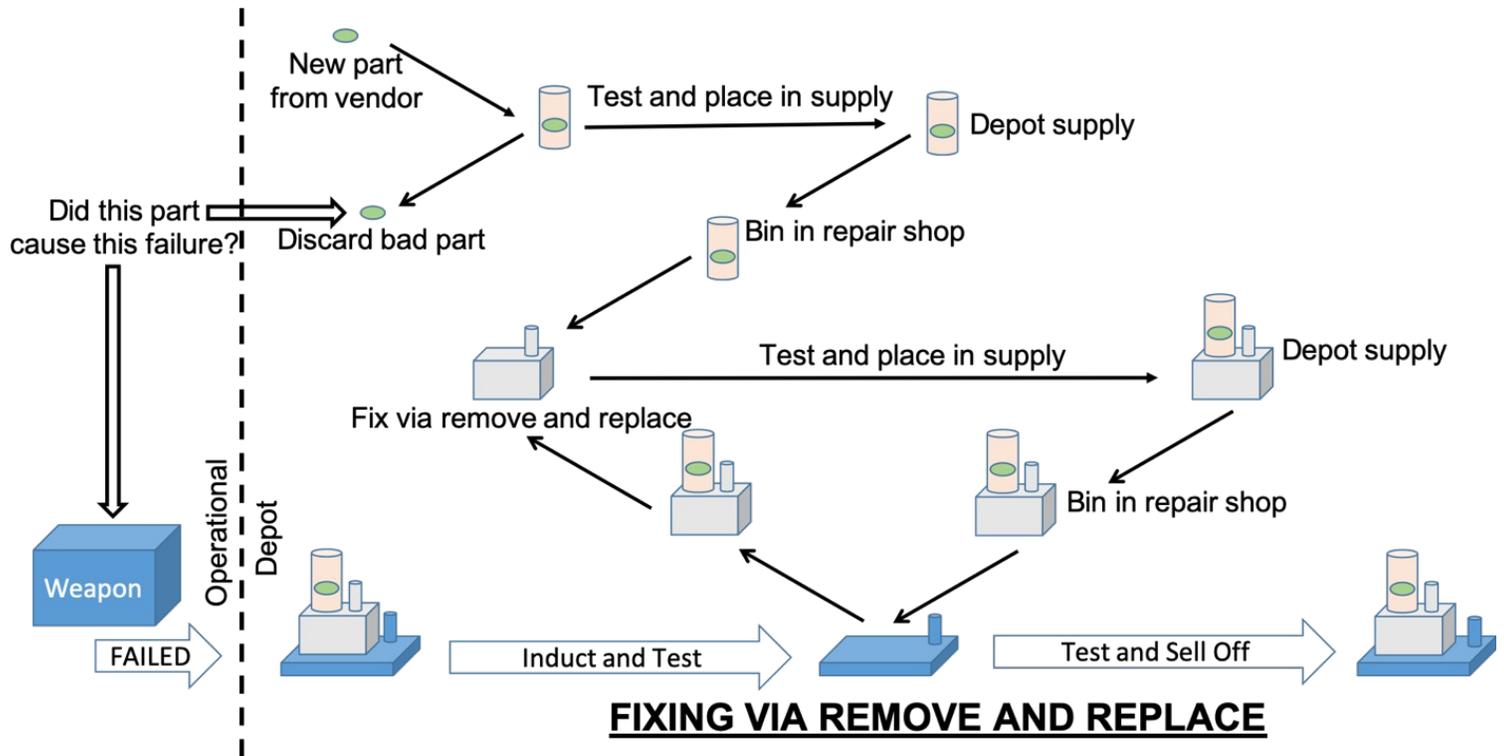
Figure 1,2: Low Lunar Orbiting Resort and a Humanities and Cultural Complex are visions proposed by space architects. [M. Thangavelu & P. DiMare]

A IAA Los Angeles-Las Vegas Section hosted a multigenerational online gathering of space architects on Saturday August 22nd, 2020. Academics and seasoned architects, engineers and practicing professionals as well as a new generation of designers discussed various aspects of humans in spacecraft, and offered a range of views on human space missions, from orbital missions to extraterrestrial settlements on Moon and Mars. Madhu Thangavelu, who conducts the Graduate Space Concepts Studio in the Astronautical Engineering department within the Viterbi School of Engineering and teaches the Space Architecture Seminar in the School of Architecture at USC invited the group, prepared the agenda and moderated the program. Roughly organized as talks pertaining to Space Architecture theory and education, orbital space habitat designs, lunar surface activities, and simulators, the program concluded with a talk about the most important aspect of human spaceflight, namely human behavior and needs for preserving the fragile psyche of the crew during long duration space missions. In the Astro studio at USC, students look outward into space to create new visions of human space activities, and in the Architecture school they ponder uses for space technologies for clean renewable energy, recycling resources, performant materials and reliable structures, agile communications and innovative aesthetics for homes and cities as the world's population grows, cities become congested and climate change takes a toll on civilization. Civil Architects are also interested in visions for humanity in space including humanitarian and cultural outer space activities.

(Continued on Page 22)

Closed Loop Failure Analysis (CLFA)

by Col. Charles Vono (USAF & TRW Retired), AIAA Distinguished Lecturer, AIAA Associate Fellow



Closed Loop Failure Analysis (CLFA) (Courtesy of Col. Charlie Vono)

This is number 6 in a 7-part series of articles about sustaining your complex system.

In last month’s newsletter, we talked about executing the various programs arising from your risk mitigation plans. The risk mitigations can vary from minor technical order changes to major modification programs. We said that, at its heart, the execution of these programs is classic program management. That is, when working these kinds of projects and programs, approaches, rules, and general flow is very similar to what a development organization would do.

In that discussion, I introduced and gave a graphic of CLFA. That graphic is repeated here and we will provide more details in this article.

CLFA is MIL-HDBK-2155 FRACAS employed at a repair depot. The DAU has a great summary of FRACAS. For instance,

Failure Reporting, Analysis and Corrective Action System (FRACAS) provides a disciplined closed-loop process for solving reliability and maintainability issues at the design, development, production and fielding phases of the life cycle of a system. It is an essential element of any reliability and maintainability program found in defense systems.

In short, FRACAS keeps an eye on parts and systems failures in production and after deployment. A Failure Review Board helps decide if the system design, production processes or equipment, or other production areas require changes. FRACAS might lead you to switch parts suppliers, change your final acceptance test, improve your production equipment, upgrade your data systems, or any number of other facets of production.

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Air Force Is Conning the Ship

A joint warfighter... 10 cats and traps on 8 carriers! A story of Lt. Col. Mark Hasara's last trip to the carrier at sea, right after Operation ANACONDA in April 2002.

by Mark R. Hasara, Lt Col, USAF, (ret), Author of *Tanker Pilot: Lessons from the Cockpit*

(The 2nd Speaker in the AIAA LA-LV e-Town Hall Meeting on 10 October, 2020, <https://conta.cc/3ep6vqa>)



Sluggo Viking – Lt. Col. Mark Hasara in the cockpit

0930 Monday 25 March 2002

Onboard a VRC-40 C-2 Greyhound

Flying to the USS John F. Kennedy in the Indian Ocean

Conan, a B-1 weapons system operator and member of General Mosley's Commander's Action Group, or CAG, was looking for me, said the sticky note on my desk. The rumor that Conan and General Moseley's CAG were building a brief to answer the Army's noise about the lack of Air Force support in Anaconda, but no one had confirmed the brief's existence. The bigger rumor was that an inter-service feud was brewing between the 10th Mountain and Air Force leadership.

Big Army blasted the Air Force in the mainstream media for not giving 10th Mountain ground forces the air support they needed, which was pure bovine feces. I found Conan later that the afternoon carrying a relatively large PowerPoint brief in his left hand. Its cover page stated: "Ninth Air Force Report on Operation Anaconda."

"Show me this brief I hear does not exist," I said as Conan and I leaned over the admin counter.

"You can see it, Sluggo, but I can't give you a copy. It's still rather sensitive."

"Oh, come on, Conan—there's no bad blood in the media

between Big Army and Big Blue!"

Conan chuckled and laid the brief on the desk between us. The rivalry rumor was true because the Air Force's answer to the 10th Mountain complaints lay before me.

Conan asked for my air refueling input. The old business adage is true in combat and defined air refueling support to Anaconda: you can have it quick, cheap, or easy—but you can only have two. If you want it quick and easy, the product will never be cheap. Air Mobility Division and my air refueling team received late notification of the 10th Mountain's support requirements. Anaconda's big spike in fuel consumption was not cheap and was directly related to our receiving tanker requirements only five days before Anaconda's kickoff. Understating requirements drove fuel costs through the roof after the increase in airborne artillery needed for Petty Officer Neal Roberts and RAZOR 03's rescue. Acts of God, such as Neil Roberts's falling off RAZOR 03, are never anticipated. A rescue operation looking for and fighting over downed troops always drives refueling and gas requirements higher.

Once Anaconda began, shifting battlefield objectives and a poor command and control setup caused delays on the battlefield, again driving fuel costs higher as fighters and bombers waited over targets. Our one-hundred-thousand-pound fuel reserve in Snooze's KC-10 orbiting near the Shah-i-Kot evaporated in the afternoon of the first day.

A quarter of the refueling control events required drogues for Navy fighters, and there were not enough in the theater if we were to go to war in Iraq. Strike aircraft returning with retained weapons needed more gas, because heavy attack aircraft consume ridiculous amounts of fuel. Bringing fighters from the Jab in Kuwait several times a day on nine-hour-plus sorties threw every refueling plan off when they stayed past their three-hour station times. The approval process for clearing US aircraft to refuel from international tankers took too long, and the matrix used to schedule receivers to tankers was not up-to-date. I handed my notes to Conan and asked where the brief went from there.

"First stop is COMACC, General Hornburg. He'll have to fight Big Army over this one."

"Well, if you need any more input, see Gramps. I'm leaving for a couple of days."

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Obituary: CDR Robert A. “Bob” Johnson, USN (Ret) (1947-2020)

“CDR Robert A. Johnson was the speaker for the AIAA LA-LV AF-447 Aircraft Safety (2017) and the Carrier Landing (2018) events, both held in the Northrop Grumman S-Cafe.”

by Jay A. Campbell (with permission from The Society of Experimental Test Pilot (SETP))



CDR Robert A. “Bob” Johnson, USN (Ret) (1947-2020)
(Courtesy of SETP)

The Society was saddened to learn of the “Last Flight” of CDR Robert A. “Bob” Johnson, USN (Ret) (M) on 7 June 2020. He was 86 years old.

His wife Gail and three sons were by his side. Bob was born in northern Wisconsin in the small farming community of Brill, WI. He and his brothers grew up in that rural environment and spent countless hours at Rice Lake. Bob developed an early love for aviation and attended the University of Wisconsin on an NROTC scholarship, graduating with a BS in Civil Engineering and a BS in Naval Science, receiving his commission as an Ensign in June 1957. Right after graduation he and Gail, his wife of nearly 63 years were married in Berwyn, IL, just outside of Chicago, on June 28, 1957.

Bob earned his Wings of Gold on 21 November 1958 after Basic Training in the T-34B and T-28B/C at NAS Pensacola, FL and Advanced Training in the F9F-8T at NAS Beeville, TX. While he was in flight training, both of his scheduled CARQUALs were cancelled in the T-28 and F9F-8 due to hurricanes. His logbook was stamped “FIELD QUALIFIED” and he pressed on to his Fleet assignment as the first “Nugget” pilot to fly the A-3D. However, due to attrition of the community’s B/Ns, he initially trained and flew as a B/N until the pipeline caught up. While in route to this assignment he attended A-3D Maintenance Officer Training at NAS Alameda, CA where he bagged time in the T-33 to remain current. Finally transitioning to the pilot seat in VAH-123 at NAS Whidbey Island, WA, Bob made his very first carrier arrested landings in the A-3D aboard USS Kitty Hawk before reporting to VAH-4. He embarked in USS Oriskany in late 1959 for his first deployment to the Western Pacific where the airwing responded in support of the Taiwan government during the Quemoy-Matsu Islands crisis. His second deployment with VAH-4 was embarked in USS Lexington, again to the Western Pacific during the early 60’s when the bombing of South Vietnam President Diem’s palace required numerous sorties showing U.S. presence for support of South Vietnam prior to the Tonkin Gulf incident. Notably, for the entire USS Lexington deployment the airwing flew with a field mirror landing system chained to the deck on the STARBOARD side of the landing area (check your scan in-close!) and they operated still flying the night “VFR” pattern. Whales, both day and night, coming aboard 27C Carriers...precision required!

Bob’s first shore duty tour took him to the Navy Post Graduate School in Monterey, CA from February 1963 to June 1965 where he found flight time in the T-2A while earning his MS Degree in Aeronautical Engineering. Rolling back to the fleet, Bob transitioned to flying the RA-5C, training at RVAH-3 before joining RVAH-13 at NAS Sanford, FL. He made two deployments while in RVAH-13, first embarked in USS Kitty Hawk and next embarked in USS America, deployed to WESTPAC and combat from Yankee Station in the Tonkin Gulf.

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Leak on International Space Station -- 2020

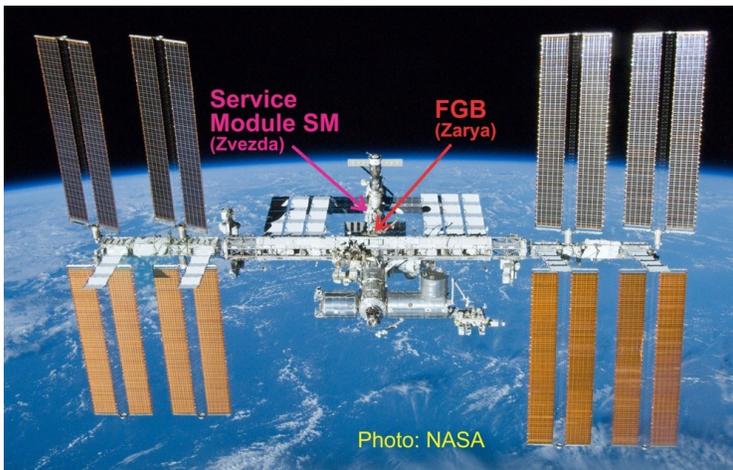
by Mike Gruntman, Professor of Astronautics at USC, astronauticsnow.com (1 October, 2020, with permission)

<https://www.linkedin.com/pulse/leak-international-space-station-2020-mike-gruntman>

Recent days witnessed significant increase in leak of air from the International Space Station.

A small leak was first detected in September 2019. Its rate doubled in the late August of 2020. The ISS crew, cosmonauts Anatoly Ivanishin and Ivan Vagner and astronaut Chris Cassidy, isolated different parts of the station, trying to pinpoint the leak. No success then.

A few weeks later in September, the rate increased again. The crew identified now a section of the ISS Service Module (SM, or Zvezda) where the leak is located (photo below). Launched in 2000, SM became the third ISS module that together with the earlier launched FGB (Zarya) and Node-1 (Unity), served as the “founding” building blocks of the station. SM plays a major role in the life support system of the entire International Space Station.



A Russian information agency, RIA, reported on September 29, 2020 (with references to Roscosmos) that the leak had increased to 1.4 kg per day with the associated “general atmospheric pressure drop at the level of 1 mm [of mercury, or torr] in 8 hours.” The latter number means 3 mm Hg (or torr) per day.

Recall that in August 2018, an obscured drill hole caused a leak in a Russian Soyuz MS-09 vehicle docked to ISS. I posted then a short video on YouTube analyzing (with

related equations) the leak -- <https://youtu.be/5q1G1-m2zGw>.

Let us apply a similar analysis to the current leak and put it into perspective.

First, there is inconsistency between the reported pressure drop and mass loss. For a total mass of air on ISS 1100 kg and mass loss of 1.4 kg/day, the associated pressure loss should be about 1 mm Hg (or torr) per day, about three times smaller than the reported rate. It is likely that additional air is added from the ISS storage which could explain this discrepancy.

If the 3-torr/day pressure loss is correct, then the mass loss is about 4.4 kg/day or 0.051 g/sec. This mass loss is about 15 time smaller than the mass loss due to the drill hole discovered in 2018.

The current leak could be caused by a perfectly shaped opening with an area of about 0.2 square millimeter. All real holes are not perfectly shaped (this is described by the so called discharge coefficient), so the opening area is actually a little larger, perhaps 0.6 mm (3/128”) in diameter. If it is a narrow long slit (such as a crack), then the effective area would be larger.

Dealing with a small leak is not a major problem logistically or financially. Mass loss of 4.4 kg per day translates into 1600 kg per year. At a cost of \$10,000 for delivery of 1 kg to ISS, it would require only \$16M each year to replenish the lost air.

The real problem is that the leak could become bigger and develop into a larger and dangerous problem. It is essential to find it and seal as quickly as possible.

Finding small leaks is very difficult. (Incidentally, not that anybody asks me, finding a technical solution could be an excellent and urgent topic for NASA’s SBIR program.)

Ad astra.

COVID-19 U.S. Mortality Trends

by Daniel R. Adamo (adamod@earthlink.net),
Independent Astrodynamics Consultant, NASA JSC – Retired,
AIAA Distinguished Lecturer / Mentor, AIAA Associate Fellow

Introduction

Situation awareness is vital to effective decision-making in a crisis, but statistics are a perilous route to that end unless their pedigree is understood. An explanation of what this paper presents on Corona Virus Disease-2019 (COVID-19) mortality in the U.S. is therefore in order.

Statistics for this paper are obtained from URL <https://corona.help/country/united-states#chartsnav> (accessed 28 March 2020), an altruistic effort reliant on multiple data sources.¹ These data are each associated with a specific date reckoned according to Coordinated Universal Time (UTC). Similar statistics are available from corona.help at the international and state levels, but this paper focuses on the U.S. because it is of general reader interest and because most states have yet to develop a COVID-19-afflicted population whose size is sufficient for reasonably stable analysis, including trends.

The paper further focuses on two *cumulative* (as distinct from other tallies that could decrease with time) U.S. COVID-19 statistics: cumulative infections and cumulative deaths. No attempt is made to analyze cumulative infections data because they are dependent on how/where/when the U.S. population is being tested for COVID-19, all of which are in a state of flux. In contrast, death counts are deemed to be relatively reliable and consistent in pedigree over time. Deaths typically result from serious cases admitted to hospitals that are likely to undergo testing for COVID-19. However, the following caveats regarding the cumulative deaths statistic should be noted.

- 1) If a deceased patient has tested positive for influenza, a COVID-19 test will generally not be administered. Up to 20% of COVID-19 victims are estimated to have also been infected with influenza.
- 2) Nasal swab tests for COVID-19 may produce false negative results in up to 40% of subjects.
- 3) Some COVID-19 deaths occur without hospitalization and are unlikely to be tested postmortem unless homicide is suspected. These untested deaths may even proliferate in hospitals if they become overwhelmed with patients (there is no nationwide policy on whether or not to attribute cause of death to COVID-19 based only on

symptoms).

The foregoing caveats conspire to produce cumulative death tallies at any UTC that are smaller than reality. In addition, cumulative infections and cumulative deaths exhibit huge variations in their geographic distribution across the U.S.²

In summary, cumulative U.S. COVID-19 deaths are always subject to counting errors. Nevertheless, such data are a meaningful indicator of *trends* in how the disease is taking its toll over time. Consequently, trends in cumulative U.S. death tallies are viewed to be significant indicators of the success mitigating policies such as social distancing are having nationwide.

COVID-19 U.S. Mortality Trends

These trends may also reflect the degree to which health services are becoming overwhelmed by COVID-19 infections. It should also be noted cumulative deaths are a lagging statistic with respect to cumulative infections. Thus, any trends inferable from cumulative deaths will be delayed to some extent. Tracking cumulative U.S. death trends from COVID-19 is the primary objective of this paper.

Exponential Growth

In the absence of mitigating factors, including attrition from death or immunity following survival or vaccine administration, communicable viruses like COVID-19 spread *exponentially* with time. This phenomenon is characterized by infection and death increases at any time being proportional to cumulative infections and cumulative deaths, respectively, up to that time.

Figure 1 plots these cumulative statistics using *linear* scaling with a constant 20,000 infections or deaths per major division.

¹ These sources are listed at <https://corona.help/page/about> (accessed 28 March 2020).

² Reference the map at <https://infection2020.com/?r=1&fbclid=IwAR3XcLo5orBGJQKvFvjRJRru44nwPLIwcTSCo721ltAGrVF276qOOHTLOI> (accessed 30 March 2020).

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The S.S. Kalpana Chawla will remain docked to the International Space Station for approximately three months

<https://news.northropgrumman.com/news/releases/northrop-grumman-cygnus-spacecraft-berths-with-international-space-station> (October 05, 2020) (With Permission)

WALLOPS, Va. – Oct. 5, 2020 – Northrop Grumman Corporation’s (NYSE: NOC) Cygnus spacecraft was successfully captured by Commander Chris Cassidy of NASA using the International Space Station’s robotic Canadarm2 at 5:32 a.m. EDT after its launch on the company’s Antares rocket on Oct. 2 from Wallops Island.



Northrop Grumman’s Cygnus spacecraft was successfully captured by Commander Chris Cassidy of NASA using the International Space Station’s robotic Canadarm2 at 5:32 a.m. EDT after its launch on the company’s Antares rocket on Oct. 2 from Wallops Island. (Courtesy of Northrop Grumman)

The S.S. Kalpana Chawla executed a series of thruster burns during its three day journey to the station. Once Cygnus was in close range, crew members grappled the spacecraft with the station’s robotic arm. Cygnus was then guided to its berthing port on the Earth facing side of the station’s Unity module and officially installed to the space station at 8:01 a.m. EDT.

“The S.S. Kalpana Chawla has successfully completed the first part of its mission with its arrival at the International Space Station,” said Frank DeMauro, vice president and general manager, tactical space systems, Northrop Grumman. “Northrop Grumman is proud to support both NASA and our commercial partners as we continue to play a critical role in support of humans living and working in space.”

Cygnus will remain berthed to the International Space Station for approximately three months while more than 8,000 pounds of cargo is unloaded and astronauts reload the vehicle with disposal cargo. Cygnus will then undock and complete its secondary mission of hosting both the

Northrop Grumman-built SharkSat payload and the Saffire-V experiment. The SharkSat prototype payload is mounted to Cygnus and will collect performance data of new technologies in low Earth orbit. To learn more about these payloads, visit Northrop Grumman’s [website](#).

Northrop Grumman solves the toughest problems in space, aeronautics, defense and cyberspace to meet the ever evolving needs of our customers worldwide. Our 90,000 employees define possible every day using science, technology and engineering to create and deliver advanced systems, products and services.

About the Mission

Northrop Grumman is proud to name the NG-14 Cygnus spacecraft after former astronaut Kalpana Chawla. It is the company’s tradition to name each Cygnus after an individual who has played a pivotal role in human spaceflight. Chawla was selected in honor of her prominent place in history as the first woman of Indian descent to go to space.



*Astronaut Kalpana Chawla (March 17, 1962 – February 1, 2003)
(Courtesy of Northrop Grumman)*

A Note from Prof. Scott E. Palo (AIAA SmSat TC) ([See Page 14](#)):

Astronaut Kalpana Chawla is a graduate of CU (See <https://www.colorado.edu/aerospace/2020/09/10/spacecraft-named-late-astronaut-and-cu-boulder-graduate-kalpana-chawla>). She is one of 20 astronauts associated with CU (<https://www.colorado.edu/aerospace/about-us-visiting/astronauts-affiliated-cu>) and the second to be lost in a Shuttle disaster. The first was Ellison Onizuka who was on Challenger.

NASA Receives First Lunar CubeRover from Astrobotic

Astrobotic fulfills NASA's \$750k SBIR contract for developing a lightweight planetary rover

by Astrobotic Technology, Inc., on 24 September, 2020 (with Permission)



<https://www.youtube.com/watch?v=gUVb9g7R9Xk>

Pittsburgh, PA – After three years of intensive engineering work, Astrobotic's CubeRover is on its way to NASA's Kennedy Space Center in Florida. The CubeRover is designed to provide an affordable mobile outlet for scientific instruments and other payloads to operate on the surface of the Moon. This occasion marks the first time Astrobotic's Planetary Mobility department has delivered rover hardware to an outside entity.

Named for its modular, scalable design, the CubeRover was co-developed with Carnegie Mellon University, with input from a NASA team at Kennedy, and marks the completion of work on NASA's \$750,000 Small Business Innovation Research (SBIR) Phase 2 contract to develop a lightweight rover with flight characteristics.

Astrobotic has since refined and commercialized the CubeRover product line with the goal of supporting mobility as a service with a variety of diverse payloads, making lunar access easier for smaller tech demonstrations and scientific investigations. The rover is also designed to be integrated onto multiple lunar landers for voyages to the Moon, facilitating its inclusion on a wide variety of future space missions.

Designing the compact CubeRover presented an array of engineering challenges for the Astrobotic and Carnegie Mellon teams. Among many concerns, the teams were tasked with regulating the rover's temperature in extreme climate fluctuations, keeping its mass minimal, and ensuring the rover maintained optimum mobility for instruments operating on the rover. The teams created a robust thermal design able to endure temperatures ranging from space (-455°F) to the lunar surface (260°F). The result is the lightest commercial planetary rover ever created. The CubeRover was also outfitted with a

calibrated camera used to orient itself relative to known objects on the lunar surface, such as Astrobotic's Peregrine lander. The ability for the rover's operation team to recognize its position on the Moon augments the value of the data, allowing payload customers to make informed decisions about where to travel next.

“Because our CubeRover is so light — in the four kilogram range — it dramatically reduces flight cost, making the Moon more accessible to more customers,” says Mike Provenzano, Astrobotic's Director of Planetary Mobility. “We're also including industry standard interfaces throughout the rover to simplify the payload integration process.”



Mike Provenzano, Astrobotic's Director of Planetary Mobility, poses with CubeRover.

In the coming months, a team at Kennedy's Granular Mechanics and Regolith Operations (GMRO) Laboratory will conduct a battery of mobility tests on the CubeRover in their analogous lunar regolith simulant — a terrain that closely mimics the mechanical properties of the lunar surface. These tests will measure the slopes, gaps, and other surface irregularities the rover can navigate. Drop testing will ensure the rover is not at risk of tipping over during its deployment from a lander to the lunar surface.

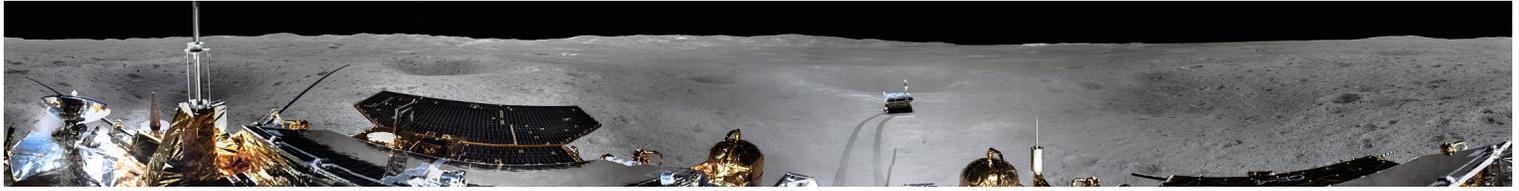
Astrobotic's work on CubeRover will continue through its \$2M Tipping Point contract with NASA, concluding in February 2022. This program funds the flight qualification of the 2U CubeRover product line, and also

(Continued on Page 49)

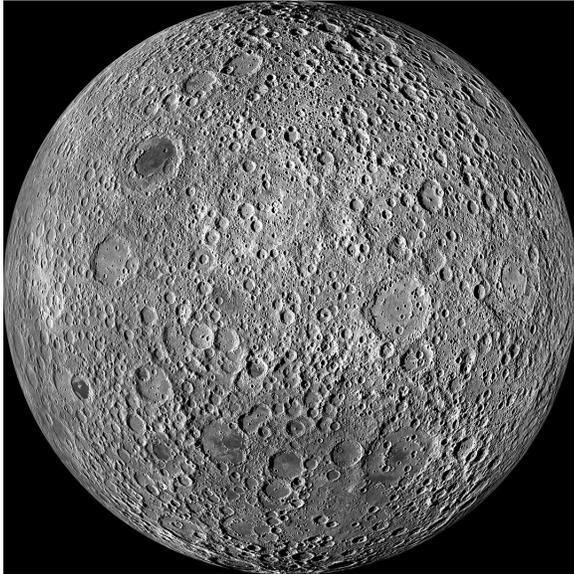
The Moon Has More Radiation Than We Thought, a New Problem for Astronauts

by Ryan Whitwam on 29 September, 2020 (with Permission – Text Only)

<https://www.extremetech.com/extreme/315614-moon-radiation-problem-astronauts>



The first panorama from the far side of the Moon by Chang'e 4 lander, with the Yutu-2 rover (Wikipedia)



The far side of the Moon, which is not visible from Earth due to tidal locking. The landing site in Von Kármán crater is at bottom center. (Wikipedia)

No one expects spacetravel to be risk-free, but we're just beginning to learn how harsh the universe can be outside our little bubble of atmosphere. A new analysis of conditions on the moon much **higher levels of radiation than expected**. The Chinese-German team claims the lunar surface is so unsafe that humans will be unable to spend long periods of time there. That could certainly complicate NASA's plans for a long-term presence.

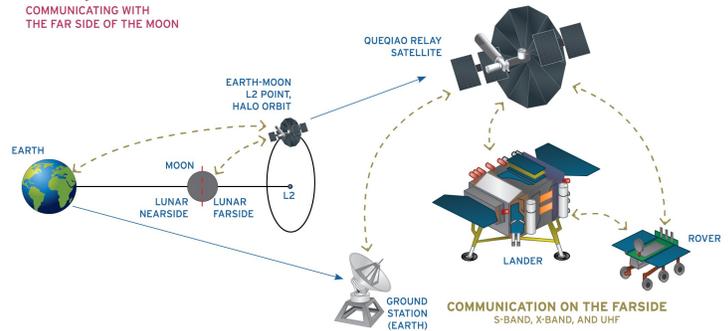
NASA took radiation measurements on the moon back in the 1960s and 1970s during the Apollo missions. Those readings proved that astronauts could spend a few days on the surface, which is all NASA needed back then. However, it did not take daily readings to determine the maximum time someone could remain on the moon. The new study does that with the help of an experiment carried out by China's Chang'e 4 lander in 2019.

Astronauts on the moon will encounter radiation between two and three times more intense than experienced on the International Space Station (ISS) and 200 times more intense than levels on Earth. Study co-author Robert

Wimmer-Schweingruber from the University of Kiel notes that you could only hang out on the moon for two months. That takes into account the radiation you'd encounter on the week-long trip to and from the moon as well. (<https://advances.sciencemag.org/content/6/39/eaaz1334/tab-pdf>)

Chang'e-4

COMMUNICATING WITH THE FAR SIDE OF THE MOON



Communication with Chang'e-4 on the Moon's far side (Wikipedia)

The study calls out several sources of radiation, including high-energy cosmic rays and solar particle events. Astronauts may also be bombarded by neutrons and gamma rays produced by interactions between the lunar soil and other forms of radiation. It all adds up to a much less hospitable environment than we'd hoped. By comparison, humans can live on the ISS with minimal risk for more than a year because the station is still partially protected by Earth's magnetic field.

Currently, NASA hopes to have humans back on the moon in 2024, and the goal is to move toward a long-term presence after that. The agency is even laying the groundwork for a space station that would remain in lunar orbit to provide crews easy access to the surface. However, extended forays to the moon will apparently require new shielding technologies. Wimmer-Schweingruber says the easiest way to make the surface safe is to build habitats with lunar soil. You'd need about 30-inches (80 cm) of soil to lower radiation levels. NASA might want to get started on that lunar sand castle technology.

Refueling the SR-71 (based on the AIAA LA-LV e-Town Hall Meeting 8 August, 2020)

by Larry Grooms, special to Aerotech News, on 12 August, 2020 (with permission)

<https://www.aerotechnews.com/blog/2020/08/12/refueling-the-sr-71/>



A KC-135 Stratotanker refuels a SR-71 Blackbird at an unknown location. The KC-135 has been in the Air Force's inventory since 1957, serving in many of our nation's conflicts and supporting the Air Force's Intelligence Surveillance and Reconnaissance mission, over the past six decades. (Air Force photograph by Joseph Simms)

Long ago declassified, yet little known secrets of the SR-71's [Cold War spy missions](#) burst into worldwide public view Aug. 8, 2020, in an aerospace industry organization's flight test of coronavirus-driven conferencing.

Blending Zoom meeting technology, pandemic health protocols and cutting-edge distance learning methods, [the Los Angeles — Las Vegas Chapter of the American Institute of Aeronautics & Astronautics](#) led off its three-segment Town Hall web show with a blast from the past. Exploding onto the video screen in his favorite Aloha shirt instead of a business suit, retired Air Force Col. Charlie Vono told tales and shared charts from his pioneering piloting years “[In-Flight Refueling the SR-71 During the Cold War](#).”

Incorporating a brief history of the rise of aerial surveillance and airpower, beginning with American Civil War balloon observers, and trench warfare spotters and concluding with thoughts about the future, Vono tailored his presentation to be understood and helpful to a general audience as well as professionals.

Anybody thinking Vono's first and longest-lasting assignment, piloting modified [KC-135 tankers](#) to refuel SR-71 Blackbirds in midair was either safe or easy, couldn't begin to grasp the level of difficult when Vono showed how each aircraft was travelling at the outer and opposite outer limits of its flight envelope. In other words, the SR-71, designed to travel at Mach 3, would fall out of the sky beyond its slow end of the envelope, while the KC-135 tanker's highest possible envelope speed was barely fast enough to stay in front of the Blackbird.

And there were complications caused by altitude, weight shifting as fuel transferred, threats of killer thunderstorms, and whatever else might happen in a mechanical way, including a tendency for some KC-135Q tankers to experience J-57 engine turbine blade failure.

Air Force Academy graduate Vono's first assignment was flying a KC-135 tanker in support of refueling SR-71s in their worldwide reconnaissance missions. Deployed from Beale Air Force Base, Calif., Kadena Air Base on Okinawa, and RAF Mendenhall, England, with Hill AFB, Utah, as the designated abort base, Vono's mission profiles required topping-off the tanks of an SR-71 just after takeoff and refueling the Blackbird again when it reached altitude. On the back side, the KC-135Q crews were responsible for meeting the SR-71s leaving hostile airspace for the return trips home. Vono recalled having as many as three tankers staged to refueling an SR mission, including Cuba.

Vono recalled that KC-135Q crews lived in a world unforgiving of mission performance error, and at a time when navigation over the Pacific still required sticking a sextant tube out the flight deck ceiling for a celestial fix on location. Radio communications over vast expanses of water were iffy, and many times tanker crews and Blackbird pilots had to maintain radio silence when they felt a high need to talk. KC-135Q commanders could offer no excuses for failure to meet the SR on time and at the right place. And the tanker crews serving Blackbirds were given their priorities from authorities as high as people living at 1600 Pennsylvania Ave.

The Cold War began in 1947 and ended in 1991, but the Lockheed SR-71 Blackbird era didn't begin until 1957 and ended in 1999. Vono's job, starting in 1977, carried through the turbulent years with the old Soviet Union and growing threats from rouge nations and rising potential [threats from Communist China](#).

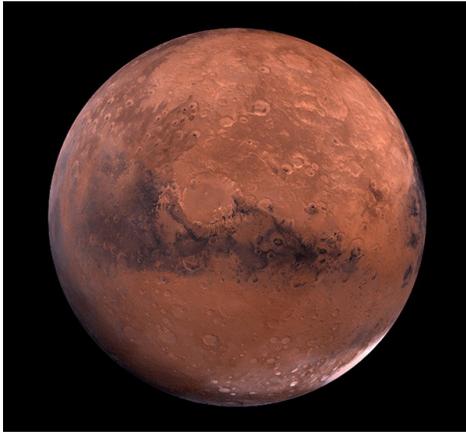
Retired from the Air Force and positions in national aerospace companies, Vono is today an AIAA Distinguished Lecturer, until recently accustomed to wearing a suit while addressing banquet halls full of colleagues in defense, technology and management. But with a new format, he now includes in his audience young students still dreaming about their future careers. Vono, whose father died when Vono was five years old, and raised by his mom in a small California Central Valley town, delivers the message that “the biggest obstacle to success in life is realizing you have a shot,” and going for it.

Looking to the nation's future in surveillance, Vono said that while there's speculation about building [a successor to the SR-71](#), “it will be something without a pilot.”

Questioning Mars as humanity's ultimate 21st century pioneering destination in space (based on the AIAA LA-LV e-Town Hall Meeting 8 August, 2020)

by Peter Merlin, special to Aerotech News on 11 August, 2020 (with permission)

<https://www.aerotechnews.com/blog/2020/08/11/questioning-mars-as-humanitys-ultimate-21st-century-pioneering-destination-in-space/>



NASA's Mars rover Curiosity captured this composite image, which looks toward the higher regions of Mount Sharp, on Sept. 9, 2015. (NASA/JPL-Caltech/MSSS photograph)

“We’re going to Mars,” President Donald Trump told reporters at a White House press conference in 2019.

Maybe not, according to astrodynamacist Daniel R. Adamo, who believes there may be no compelling reason to [put human bootprints on the Martian surface](#) anytime in the foreseeable future.

“We should pioneer on Mars only if it’s possible and ethical to thrive there economically and biologically,” Adamo said at a recent e-Town Hall meeting hosted by the Los Angeles and Las Vegas chapter of the American Institute of Aeronautics and Astronautics, held via Zoom on Aug. 8, 2020. He believes Mars has become more of a “socio-cultural destination” whose suitability for human exploration and pioneering is based on more than a century of fictional literature and poorly informed research since the beginning of the Space Age.

Adamo, a recognized authority in human spaceflight operations, retired in 2008 following 29 years as a contractor at NASA Johnson Space Center in Houston, Texas, where he supported 60 Space Shuttle missions from the Flight Dynamics Officer console in Mission Control. Since then he has been engaged in astrodynamics research, consulting and outreach for such clients as NASA, the Review of U.S. Human Space Flight Plans Committee, Jet Propulsion Laboratory, and the Keck Institute for Space Studies.

He is quick to admit that despite frigid temperatures and a thin, un-breathable atmosphere, Mars has long been the most compelling of our planetary neighbors. This phenomenon began, he says, in 1906 when astronomer Percival Lowell published a book that described the crisscrossing lines he observed on the red face of Mars as water-filled canals, possibly having been built by intelligent beings to transport water from the polar regions across the planet’s dusty landscape. This colorful image inspired Edgar Rice Burroughs to author a series of popular pulp novels, starting in 1912 with *A Princess of Mars*. According to Adamo, it was “the adventure and romance of these stories” that fired the human imagination and inspired a yearning to go to Mars. Science fiction writer Ray Bradbury penned a collection of stories, published in 1950 as *The Martian Chronicles*, suggesting that colonization of Mars was nothing less than humanity’s destiny.

The dawn of the Space Age brought such dreams closer to reality than ever before. Adamo said famed rocket scientist Wernher von Braun spent much of his time at White Sands Missile Range in the late 1940s considering the problem of sending humans to Earth’s nearest planetary neighbor. Published in 1952, *Das Marsprojekt*, offered the first technically comprehensive design for a human expedition to the Red Planet, and boldly suggested a provisional launch date as early as 1965.

The red hills of Mars

A series of robotic probes visited Mars beginning in the early 1960s but the first images returned in July 1965 showed a dead world, its rocky surface gouged by craters and jagged canyons. Even the polar ice caps were composed mostly of frozen carbon dioxide. Nevertheless, Mars remained a source of wonder. Of all the planets in the solar system, it is the one most similar to Earth. Moreover, evidence suggests that Mars was once covered largely by water and was warmer, with a thicker atmosphere, offering a potentially habitable environment.

(Continued on Page 50)

AIAA LA-LV Space Architecture Gathering 22 Aug. 2020 (Student Article)

by Elif Keve from Turkey, Student, International Space University (On the way of being an Outer Space Architect)

PANELLISTS:

1-Prof. Madhu Thangavelu (Chair/Moderator of the Panel/Event) Faculty Member, USC / ISU Chair / Moderator of this Event

2-Ms. Anastasia Prosina Founder & CEO at Stellar Amenities Award-winning aspirational futurist and practitioner in Space Architecture

3-Ms. Melodie Yashar Design Architect, Researcher and co-founder of Space Exploration Architecture (SEArch+)

4-Ms. Barbara Belvisi Founder and CEO of Interstellar Lab

5-Dr. Barbara Imhof LIQUIFER Systems Group Researcher, Univ. of Applied Arts Vienna Professor, Universität Kassel

6-Mr. Brand Griffin Program Manager Genesis Engineering Solutions Member of AIAA Space Architecture Technical Committee (SATC) ISU Faculty Emeritus

7-Dr. Marc Cohen Mission Architecture Lead at Space Cooperative

8-Dr. Jack Stuster President, Anacapa Sciences, Certified Professional Ergonomist, Author, Bold Endeavors: Lessons from Polar and Space Exploration

9-Mr. Kriss J. Kennedy Architect, Space Architect TECHNE' Architects, LLC Adjunct Assistant Professor, University of Houston-SICSA

10-Dr. A. Scott Howe Senior Systems Engineer, Space Architect, Jet Propulsion Laboratory (NASA / Caltech)

11-Mr. John Spencer Outer Space Architect Founder, President, Space Tourism Society Co-Founder and Chief Designer: Mars World Enterprises, Inc. Co-Founder and President: Red Planet Ventures, Inc.

12-Mr. John Mankins Vice President, Moon Village Association Founder and President, Mankins Space Technology, Inc. NSS Board of Directors

Key Notes From Prof. Madhu Thangavelu's Presentation:

Students in the ASTE527 studio only need to have and present an idea, it does not matter if it is true, wrong, or bad. The better thing is only having an idea and trying to ponder it to find a solution.

Dr. Thangavelu touches on the key points of essential needs of human in space such as, communication and critical space technologies needed and make living in outer space easier and more productive. This is a vital task of space architecture to find ways to keep astronauts healthy in mind and body particularly in long duration missions.

Key Notes From Prof. Olga Bannova's

Presentation:

SATC and SICSA

She introduced spacearchitecture.org and SICSA (Sasakawa International Center of Space Architecture) at Houston University. Space architecture shows the way to put your ideas into different concepts, and it allows people to tolerate and be productive in outer space for long periods, mainly as designs provides settlements with main areas where people will rest, think, and investigate as a team.

Key Notes from Prof. Anastasia Prosina's

Presentation:

Interior design of space habitats

Stellar Amenities help humanity stay sane in long-duration space missions.

<https://stellaramenities.space/>

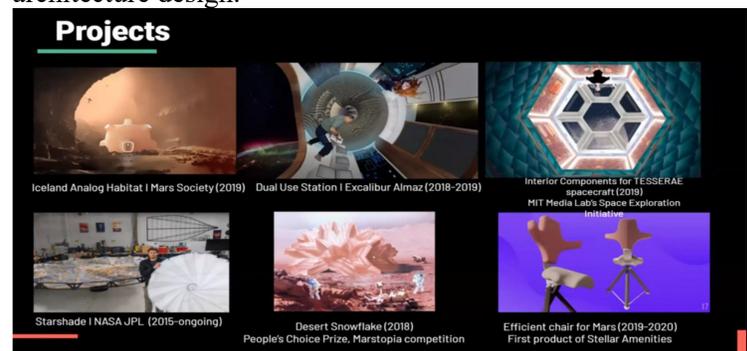
Existing issues in space habitats,

- Arising demand of the private space sector with no developed design solution

- Inefficient use of interior space. No multi-purpose and reconfiguration approach

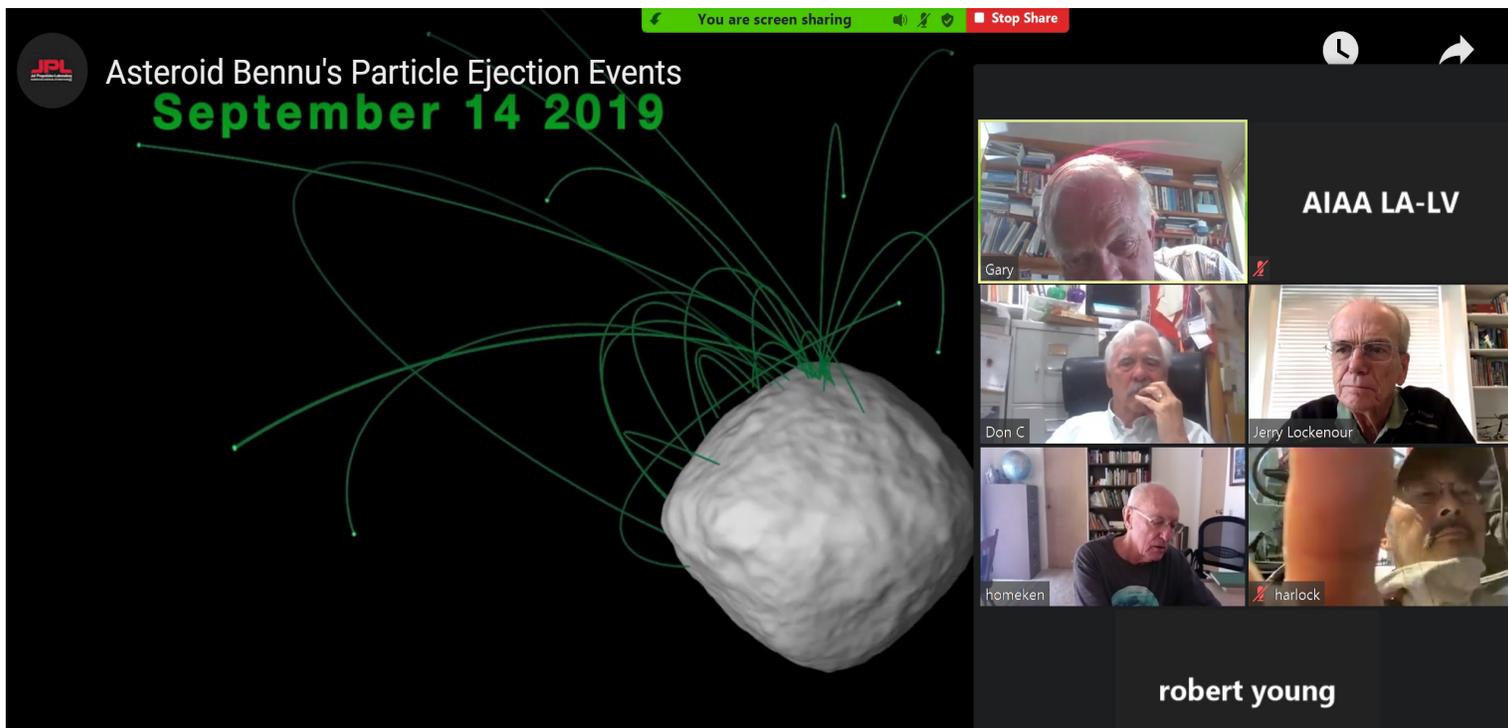
- Psychological and physiological issues faced by the new crew due to the lack of a pleasing design

When architects create a vision, engineers make vision a reality. However, when engineers create a space structure, architects provide interior design vision. Going to space is risky and there is no chance to go out to enjoy, surrounded by a waterfall, a forest and so forth. But still users in space architecture are extending, they are not only astronauts but also a lot of countries joining space industry and doing different projects which will be needed for outer space architecture design.



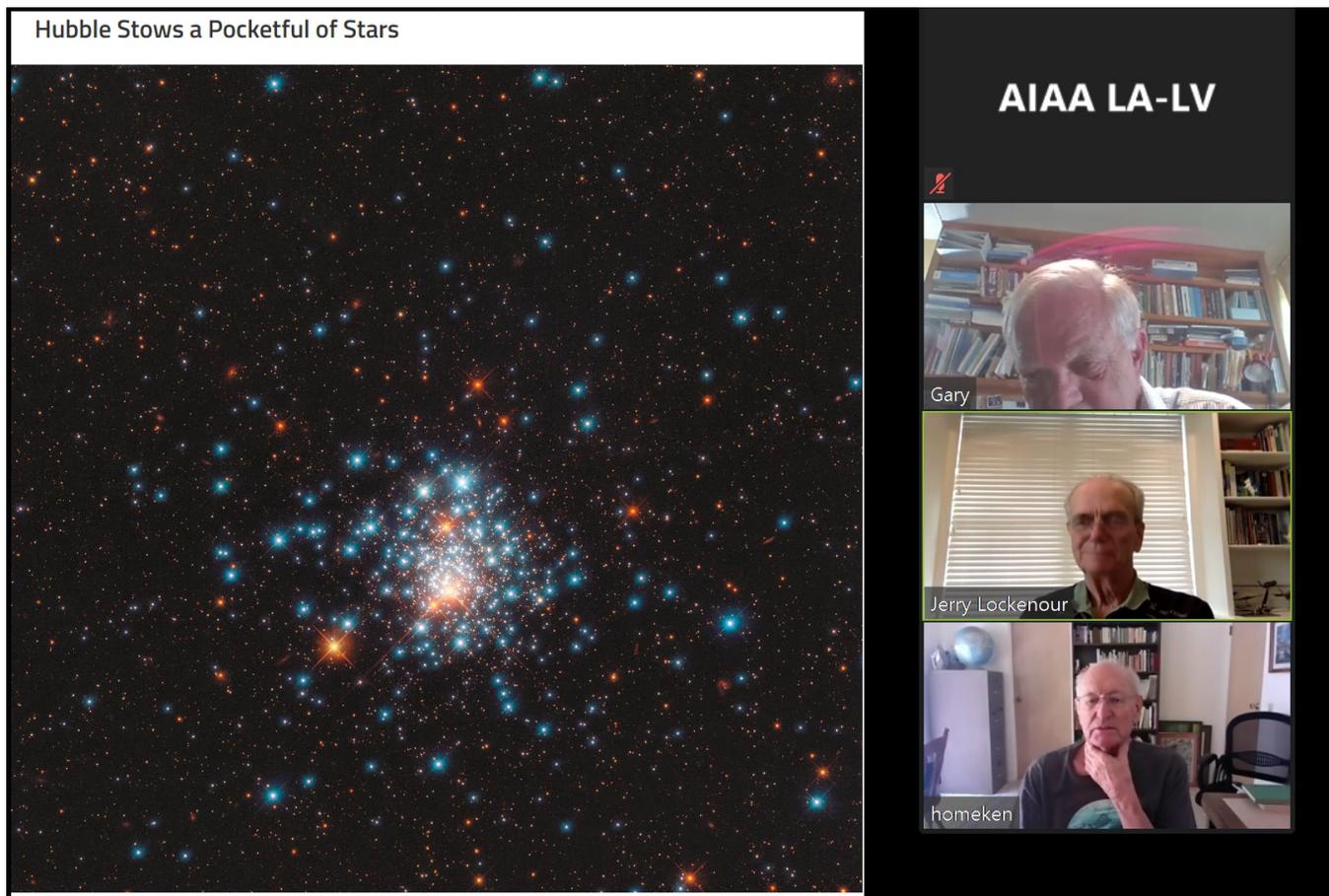
(Continued on Page 52)

AIAA LA-LV Aero Alumni September Meeting (16 September, 2020) (Screenshots Only)



Attendees discussing on the issue of "Why Is Asteroid Bennu Ejecting Particles Into Space?"

<https://www.jpl.nasa.gov/news/news.php?feature=7743>



A brief discussion at the end about the New Hubble image featuring thousands of multi-colored stars that NASA called a "pocketful of stars."

<https://www.nasa.gov/image-feature/goddard/2020/hubble-stows-a-pocketful-of-stars>

AIAA LA-LV e-Town Hall (19 September, 2020) (Screenshots Only)

Part I: University Cubesat Work During the COVID-19 Pandemic with Prof. Scott Palo and his students

Part II: AeroDesign Team of USC: The 2019-2020 AIAA DBF 1st Place Winners

Part III: The Nuclear Thermal Propulsion Rocket (NTPR) @ UNLV (Valerie Lawdensky)

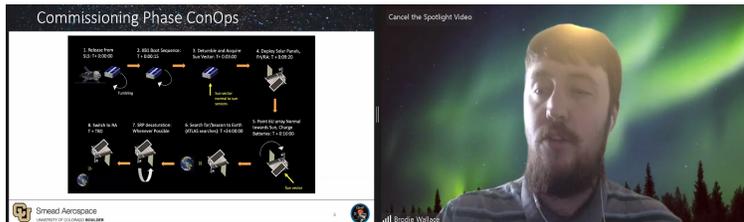
<https://aiaa-lalv.org/september-19-2020-cu-cubesat-during-covid-19-w-dr-palo-students-aerodesign-team-of-usc-aiaa-dbf-1st-winner-unlv-ntpr-valerie-lawdensky/>



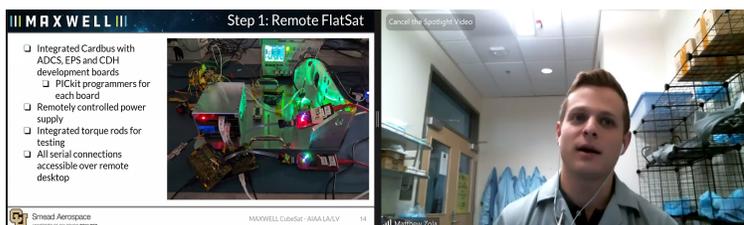
Prof. Scott E. Palo introducing his research, projects, and the three student speakers.



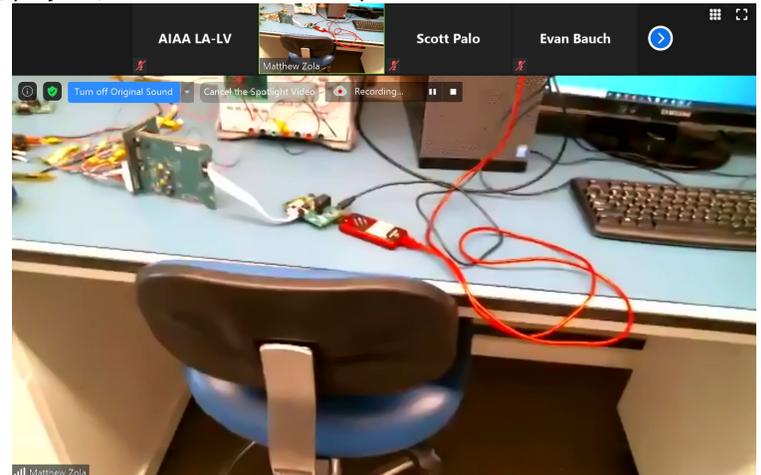
Evan Bauch presenting the CIRBE project status and timeline, showing the impact of COVID-19 Pandemic and the Engineering Design Unit: Blue Canyon XB-1 and REPTile-2 Payload.



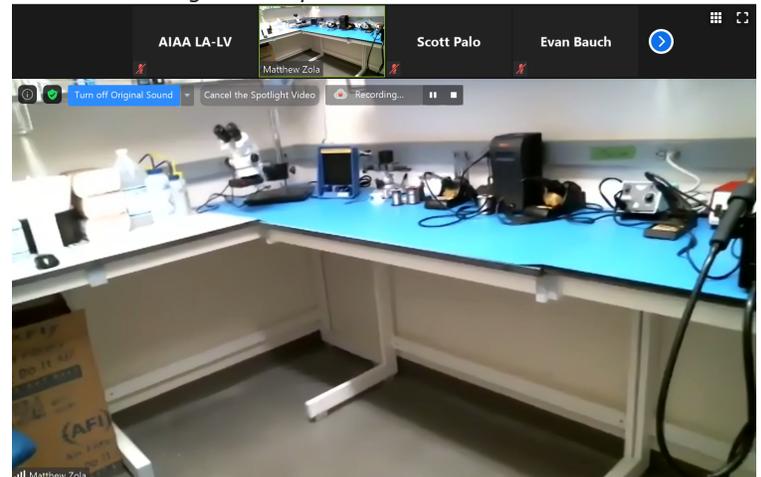
Brodie Wallace showing the Commissioning Phase ConOps for the CU-E3 project he has been working on.



Matthew Zola showing his Maxwell CubeSat – Step I: Remote FlatSat and the featured setup that facilitated the work during the Pandemic. This setup was what was featured in the AIAA Aerospace America early this year during the COVID-19 Pandemic.



Matthew Zola giving the virtual tour of the Lab, showing the special workstation designed to cope with the COVID-19 restrictions.



Workbench, as Matthew Zola walking around the Lab to show the attendees for a special (virtual) field trip! Thanks a lot!

(Continued on Page 54)

USC AeroDesign Team Takes First Place for the Third Time at the Annual AIAA Design/Build/Fly Competition *by Avni Shah | June 3, 2020 (with Permission)*

<https://viterbischool.usc.edu/news/2020/06/usc-aerodesign-team-takes-first-place-for-the-third-time-at-the-annual-aiaa-design-build-fly-competition/>

From among 113 teams around the world, USC students came in first in the remote fly-off and also won best report at the 2019-2020 competition.



USC AeroDesign's 2020 Aircraft SCKYFALL, The Winner of this year's AIAA DESIGN/BUILD/FLY Competition. [Photo/USC AeroDesign.]

The USC Aerodesign team does not shy away from challenges, and faced with this year's AIAA Design/Build/Fly challenge, they proved formidable. Despite the fact that the competition, originally scheduled to be in-person in mid-April in Wichita, Kansas, took place remotely, the University of Southern California team proved its superior technical skills, coming in first for the third time since 2014 and winning the \$3K prize. The team also was awarded "Best Report" for the third year in a row.

Said Chief Engineer of the 2019-2010 USC Aerodesign team Michael Tawata: "I think our team showed incredible resilience to the unprecedented number of changes that required rapid pivoting and design rework."

This year's challenge was to build a banner-towing bush plane. The aircraft had to take off with a banner of at least 10 inches stowed, release the banner after takeoff, tow the banner for as many laps as possible in a ten-minute window and then release the banner before landing. The USC Aerodesign team decided a competitive aircraft would fly 39 passengers and tow a 450-inch banner.

[2020 AIAA Design / Build / Fly - USC AeroDesign Team Video: https://youtu.be/NkjE_gj1Xx8]

"The team holds multiple test flights each semester, which involves waking up at 5 a.m. on Sundays to go fly the aircraft and identify areas for improvement. It's not

an understatement to say we put in thousands of hours of work to ensure we've designed, built and flown the best aircraft we were capable of producing," said Ara Mahseredjian, Program Manager for the USC Aerodesign team and recent USC Viterbi graduate. "It's a labor of love."



THE USC AeroDesign Team. (From Left to Right – Back Row: Jackson Markow, Jack Ahrens, Chentao Yu, Neeraj Utgikar, Michelle Karpshin, Ben Boggs, Drew Hudock; Front Row: Lawrence Goo, Ara Mahseredjian, Randi Arteaga, Diana Salcedo-Pierece, Michael Tawata, Muqun "Sunny" Hu.) [Photo/USC AeroDesign.]

This year's in-person fly-off was cancelled due to COVID-19, so teams were scored only based on their reports, which were due in February. Some teams did submit videos of remote launches.

The design process requires learning a lot of tough lessons very quickly, said Mahseredjian. Test flights taught the team a lot about building an aircraft in such a high weight class and one of their earliest full prototypes was damaged beyond repair during its second flight, Mahseredjian said.

One hundred and thirteen teams participated in the competition. Second and third place were the Georgia Institute of Technology and the University of Nevada, Las Vegas respectively.

Said Mahseredjian: "I am most proud of our team's nonstop effort throughout the year. This year's aircraft SCKYfall was heavier, more powerful and faster than any aircraft that ADT has built in years."

Added Tawata: "While the cancellation of the flight competition was unfortunate, the challenges presented this year gave our upcoming team a strong foundation that will only make them more successful in coming years."

The 2019-20 AIAA Design/Build/Fly (DBF) Competition Result Announcement

by AIAA (provided by AIAA UNLV Student Branch)(from <https://www.aiaa.org/dbf/previous-competitions>)

The 2019-20 AIAA/Textron Aviation/Raytheon Missile Systems Design/Build/Fly Competition was unexpectedly cut short this year due to the COVID-19 pandemic. This was the 24th year for the competition and in spite of the worldwide problems caused by the spread of the virus, the competition received 143 proposals, of which 113 were selected for the competition. Of the 113 teams selected, 101 submitted a formal report. Due to the correct decision to cancel the fly-off, the DBF Organizing Committee along with AIAA and in coordination with the Premier Sponsors Textron Aviation and Raytheon Missile Systems, decided to score the competition based solely on the final report scores.

The reports were scored identically as in previous competitions. The results:

First Place (\$3,000 and \$100 for Best Report Score):

University of Southern California

Second Place (\$2,000): **Georgia Institute of Technology**

Third Place (\$1,500): **University of Nevada, Las Vegas**

In addition to the Best Report Score, the Design Engineering Technical Committee also awards a copy of the AIAA *Aerospace Design Engineers Guide* to the top ten teams. The top ten teams are shown in the table below.

The contest theme this year was a Banner Towing Bush Plane. Each aircraft was required to have a 5 foot maximum wing span. The first mission was a Test Flight with no payload for three laps within five minutes. The second mission was Charter Mission with passengers and luggage. The mission 2 score was based on the number of passengers (and luggage) flown divided by the time to fly three laps. The final mission was a Banner Flight where teams were to deploy a banner after takeoff and release the banner after crossing the finish line during the last lap but before landing. The mission score was based on the size of the banner and number of laps flown in the 10 minute mission window. Teams were also required to complete a timed ground

mission demonstrating Mission 2 passenger and luggage loading and Mission 3 banner installation and deployment. More details on the mission requirements can be found at the competition website: <http://www.aiaadb.org>.

We owe our thanks for the success of the DBF competition to the efforts of many volunteers from Textron Aviation, Raytheon Missile Systems, and the AIAA sponsoring technical committees: Applied Aerodynamics, Aircraft Design, Flight Test, and Design Engineering. These volunteers collectively set the rules for the contest, publicize the event, gather entries, judge the written reports, and in all other years, organize the fly-off. Thanks also go to the Premier Sponsors: Textron Aviation and Raytheon Missile Systems, and also to the AIAA Foundation for their enthusiastic and financial support.

Finally, we understand the enormous disappointment of cancelling the fly-off this year. The DBF Organizing Committee expends a large amount of time and effort each year creating the rules and tailoring them to a design competition of this magnitude, scoring proposals and reports and planning and executing the fly-off event. Our reward for this commitment and effort is seeing how the teams implement the rules and create aircraft designs in the reports and at the fly-off with the actual aircraft and payloads. But we also know it is nothing compared to the time and commitment made by the student teams and that this event would not be nearly as successful without the hard work and enthusiasm from all the students and advisors. If it weren't for you, we wouldn't keep doing it. AIAA has compiled footage of teams flying their planes at home. You can see what has been submitted so far [here](#) (Editor's note: link not provided). If you'd like to submit your team's footage, please upload it [here](#) (Editor's note: link not provided).

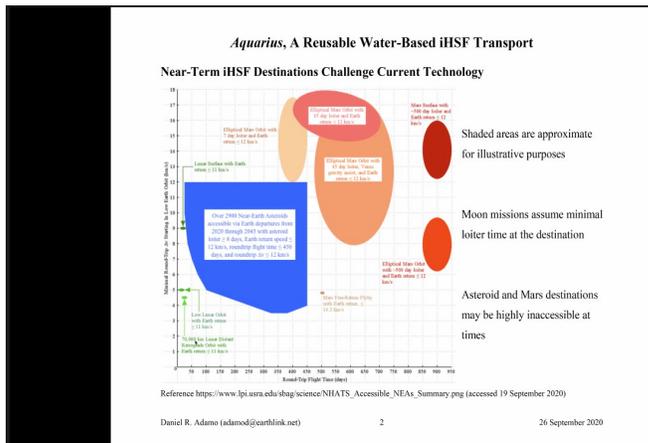
Russ Althof
For the DBF Organizing Committee

Place	Team	Award(s)
1	University of Southern California	\$3,000 (1 st place), \$100 (Best Paper Award), Design Guide
2	Georgia Institute of Technology	\$2,000 (2 nd place), Design Guide
3	University Nevada Las Vegas	\$1,500 (3 rd place), Design Guide
4	The Pennsylvania State University	Design Guide
5	The City College of New York (CCNY)	Design Guide
6	Massachusetts Institute of Technology	Design Guide
7	Missouri University of Science and Technology	Design Guide
8	The University of Alabama	Design Guide
9	Khalifa University	Design Guide
10	FH JOANNEUM University of Applied Sciences	Design Guide

AIAA LA-LV e-Town Hall (26 September, 2020) (Screenshots Only)

Part I: Aquarius, a Reusable Water-Based Interplanetary Human Spaceflight Transport (Daniel R. Adamo)
Part II: ModelCenter: Performing Multidisciplinary Analysis and Optimization (MDAO) and enabling Model Based Systems Engineering (MBSE) (Tony Davenport)

<https://aiaa-lalv.org/september-26-2020-aiaa-la-lv-e-town-hall-meeting-with-dan-adamo-and-tony-davenport/>



Mr. Dan Adamo showing his analysis Round Trip deltaV vs flight time and demonstrating the need for the Aquarius, A Reusable Water-Based iHSF Transport, based on the near-term iHSF Destination Challenges with current Technology.

PHOENIX INTEGRATION INTEGRATE EXPLORE ENABLE

AIAA Los Angeles / Las Vegas Sector

ModelCenter: Performing Multidisciplinary Analysis and Optimization (MDAO) and enabling Model Based Systems Engineering (MBSE)

Tony Davenport
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Mr. Tony Davenport explaining the philosophy and needs for a ModelCenter to integrate various engineering and scientific tools, enabling MBSE Engineering analysis and testing for the new trend in digital A & D or other engineering & design processes for innovation & safety.



Mr. Dan Adamo engaging in interactive Q&A, answering the enthusiastic questions about using Deimos for Mars Exploration Low Latency Telespresence and the Aquarius spacecraft.



Mr. Tony Davenport responding to the insightful questions from the attendees, with heated discussions and inquiries about the concepts and applications of systems integration.

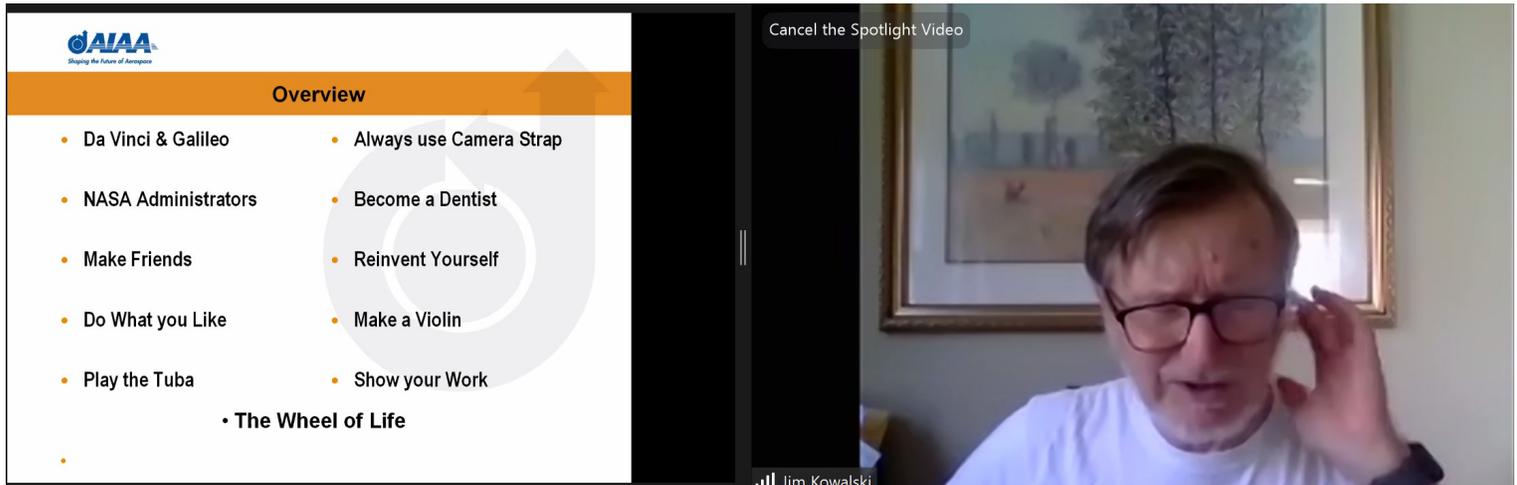
Finding Your Path: Career Development in Crisis (29 Sep., 2020) (Screenshots Only)

Setting a Path through Times of Career Transitions

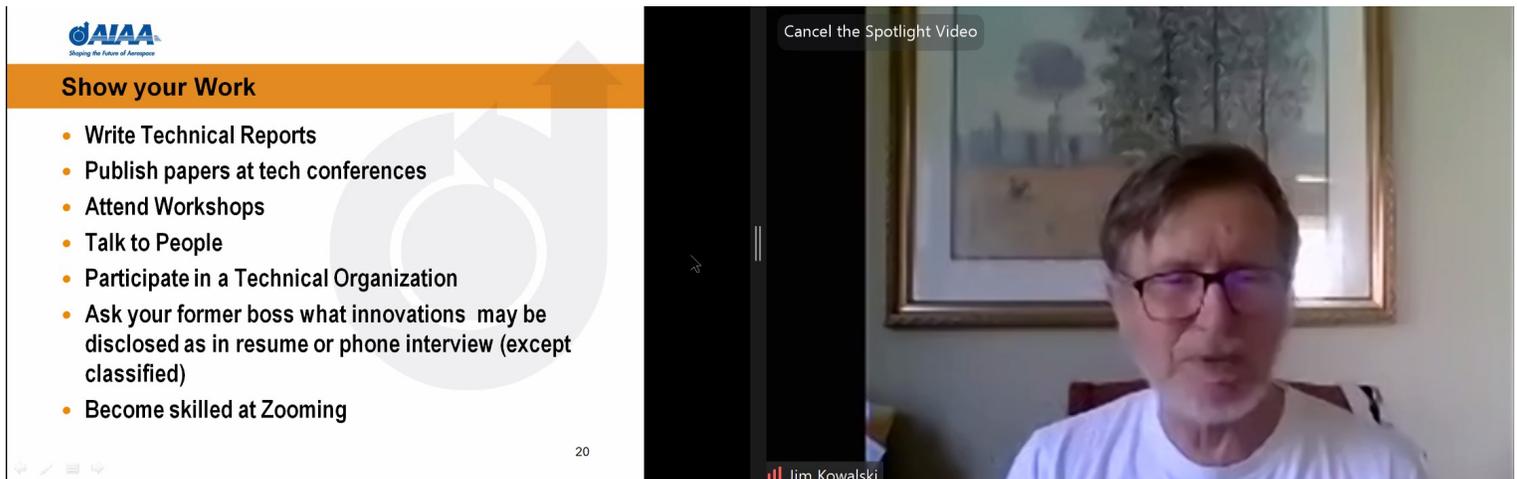
Speaker: James E. Kowalski

AIAA LA-LV Career and Work Force Development Chair

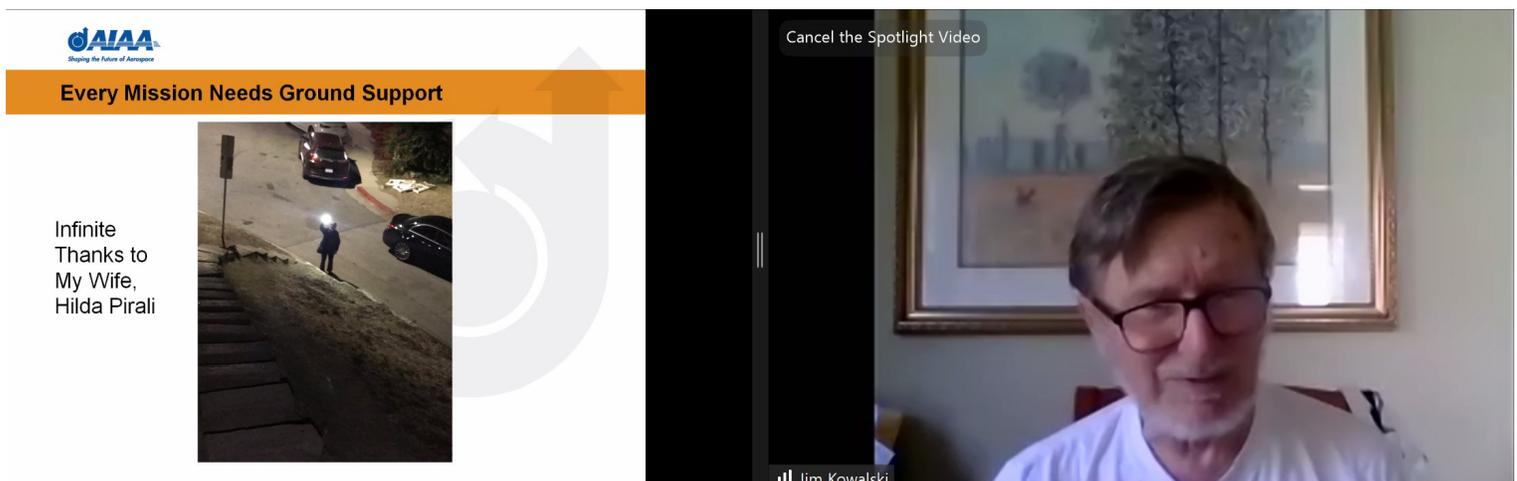
<https://engage.aiaa.org/losangeles-lasvegas/viewdocument/august-19-2020-aiaa-la-lv-proj>



Mr. Jim Kowalski (AIAA LA-LV Career and Workforce Development Chair), opening the event and outlining the presentation.



Mr. Jim Kowalski sharing the experiences and making suggestions for the transition.



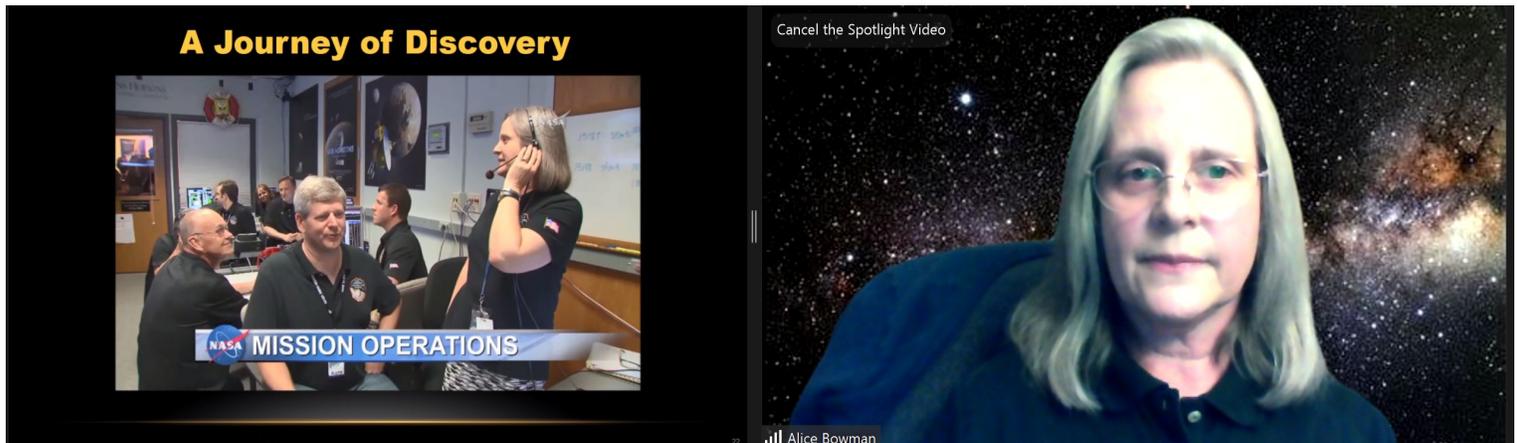
Left: Mrs. Kowalski; Right: Mr. Jim Kowalski emphasizing that the support from the family is very important during crisis and transition, and appreciating very much from the support from Mrs. Kowalski.

AIAA LA-LV e-Town Hall Meeting 3 October, 2020 (Screenshots Only)

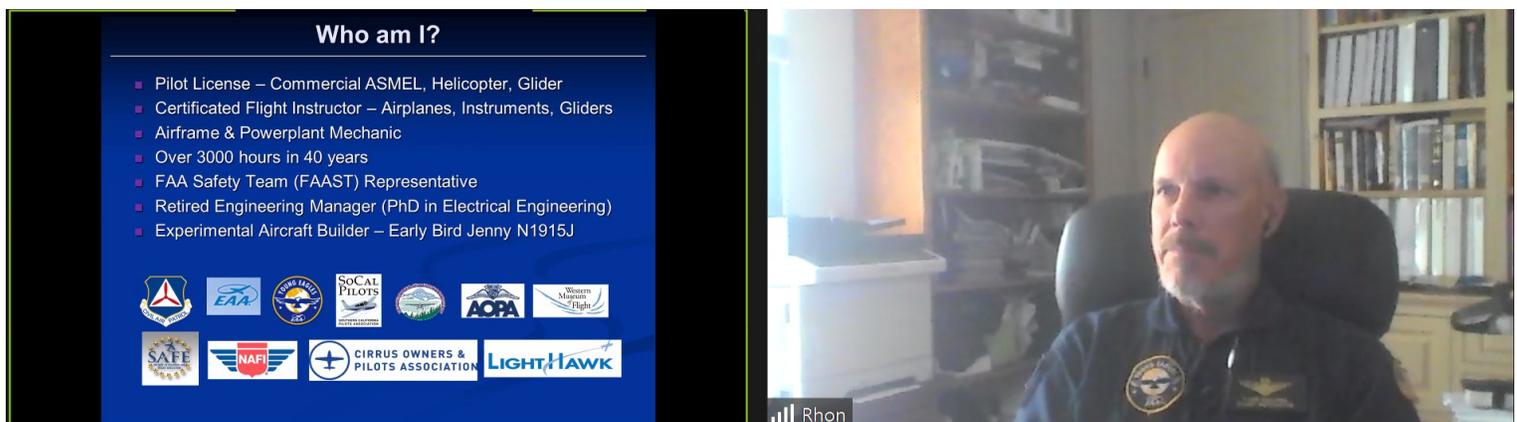
Part I: Mission to Pluto and Beyond (Alice Bowman)

Part II: Electric Aircraft Survey, Applications and Trade-offs (Dr. Rhon Williams)

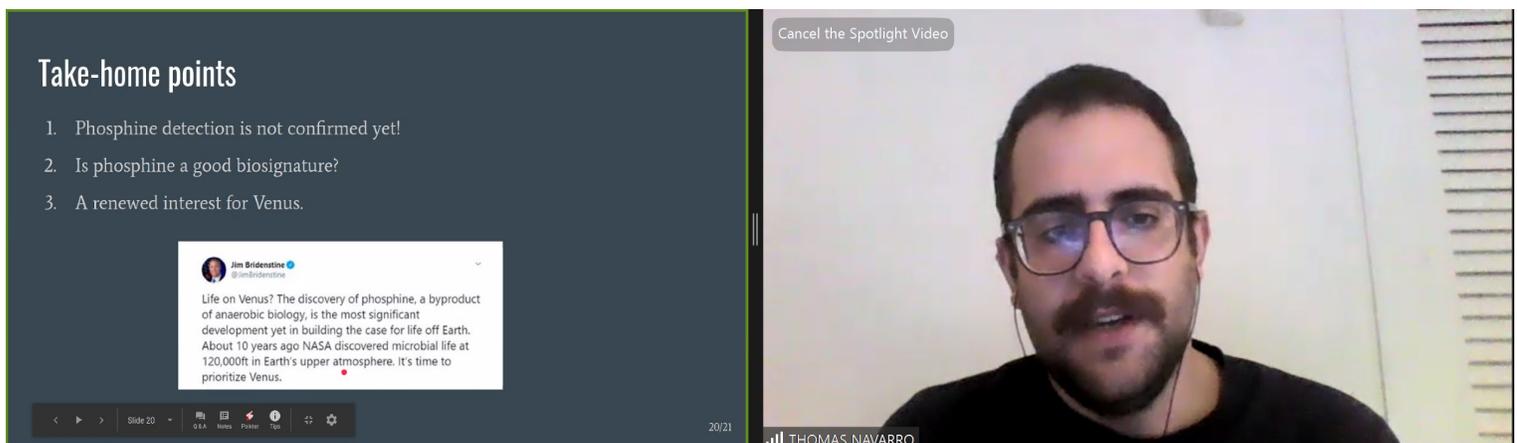
Part III: Detection of phosphine in the atmosphere of Venus (Dr. Thomas Navarro)



Left: Ms. Alice Bowman (MOM of the New Horizons Mission) announcing the successful reconnaissance of the Pluto System by New Horizons with Pluto; Right: Ms. Alice Bowman sharing her excitement of the mission, the exciting engineering feat and the resulting scientific discoveries.



Dr. Rhon Williams showing his experiences and background as an engineer, aviator, and aircraft builder, before briefing about the current technologies, designs, business of the electric and hybrid aircraft.



Dr. Thomas Navarro summarizing his talk on the recent Venus phosphine detection and possible life on Venus, giving the take-home points of his talk, and also showing a tweet by NASA Administrator Mr. Jim Bridenstine about prioritizing Venus exploration due to the recent Venus phosphine detection.

AIAA LA LV e-Town Hall Meeting 10 October, 2020 (Screenshots Only)

Part I: *Inventing the Joint Strike Fighter (Dr. Paul Bevilaqua)*

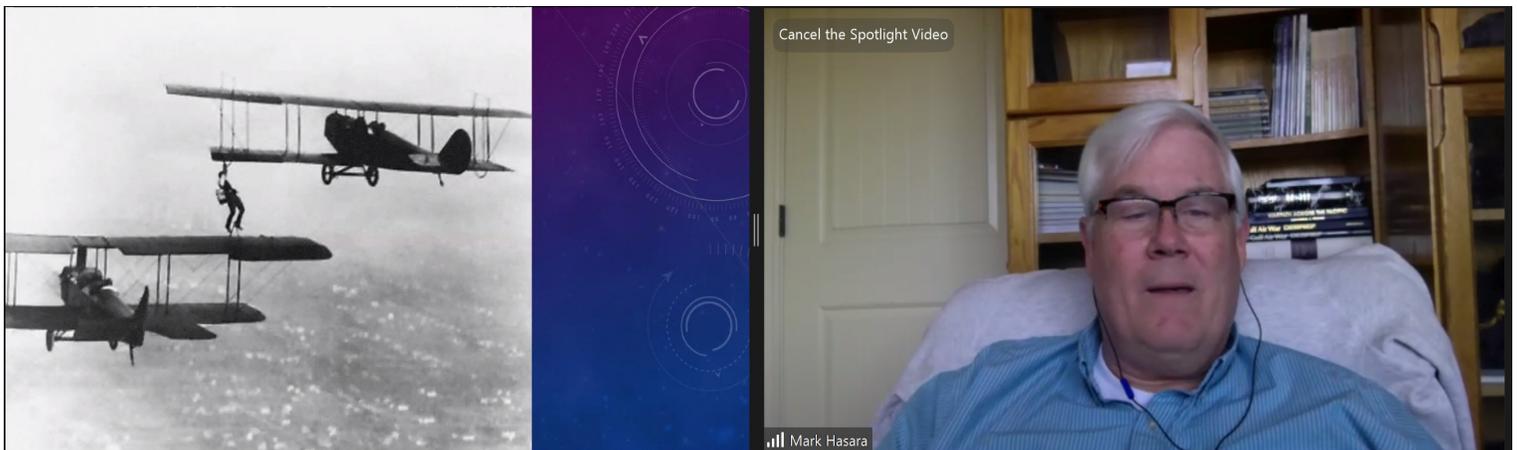
Part II: *Air Refueling (Lt. Col. Mark Hasara)*

Part III: *Climate Change and Climate Reality Project (Syreeta Watkins and Douglas Yazell)*

<https://aiaa-lalv.org/october-10-2020-e-town-hall-meeting-with-dr-paul-bevilaqua-lt-col-mark-hasara-syreeta-watkins-douglas-yazell/>



Dr. Paul Bevilaqua, AIAA Fellow & Distinguished Lecturer, reviewing the need for the Joint Strike Fighter, to open his exciting and fun lecture and Q&A.



Lt. Col. Mark Hasara reviewing the history and development of the air refueling, by an interesting archive photo of an acrobatic manual air refueling in the early stage of aviation development.



Ms. Syreeta Watkins (NASA JSC) was an invited speaker October 10, 2020, as part of 24 Hours of Reality, an annual event of VP Al Gore's Climate Reality Project.



Mr. Douglas Yazell (AIAA Associate Fellow) was also an invited speaker October 10, 2020, as part of 24 Hours of Reality, an annual event of VP Al Gore's Climate Reality Project.

Climate Reality Project for an Aerospace Audience (based on the AIAA LA-LV e-Town Hall Meeting 10 October, 2020)

by Syreeta Watkins and Douglas Yazell

The AIAA LA-LV Section online event of Saturday, October 10, 2020, consisted of three presentations. The third presentation was, "Climate Change and Climate Reality Project for an Aerospace Audience," by Syreeta Watkins and Douglas Yazell. The publicity web page at <https://conta.cc/3ep6vqa> contains an abstract and our short biographies. Ms. Watkins works at NASA/JSC as a transportation specialist and sustainability lead. Mr. Yazell worked for Honeywell aerospace engineering 1981-2011, mostly on NASA projects, and has been working as a public high school teacher since 2016. He is now certified for two subjects, Math and Technology Education, including teaching Robotics for the 2019-2020 school year.

The charts used for this presentation are a short version of the up-to-date slide show of Vice President Al Gore, who created Climate Reality Project (CRP) in 2006. The original slideshow was part of the work for which Mr. Gore won his share (50%) of the 2007 Nobel Peace Prize. CRP has now trained tens of thousands of volunteer Leaders around the world. We record Acts of Leadership on the CRP website (writing letters to editors, etc.), and the cornerstone of CRP is Leaders making presentations with this up-to-date slideshow. We typically use shorter versions of the slideshow, and we can add our own slides, too.

24 Hours of Reality has been an annual live online CRP event in recent years, featuring Mr. Gore online and on-stage for part of each hour for 24 hours, with each hour featuring guests from one of 24 nations. This year, Mr. Gore asked Leaders to make a presentation during those 24 hours. We thank AIAA LA-LV for welcoming our contribution to the 2020 version of 24 Hours of Reality. At the end of the 24 hours, at 3:00 PM Houston time Sunday, October 11, 2020, Mr. Gore will give his presentation. That might include about 500 slides instead of the 98 slides we used.

Ms. Watkins trained with CRP in Los Angeles. Mr. Yazell trained with CRP in Miami in 2015. The 3-day training is free for those whose applications are accepted (typically 3 days in a hotel prior to the COVID-19 pandemic), but travel expenses are not paid. Leaders are encouraged to volunteer as mentors in later trainings. The next training session will be in 2021, but the dates are not yet announced. The last two trainings have been global online sessions.

Mr. Yazell encouraged attendees to enjoy a 2019 book by Naomi Oreskes, "Why Trust Science?" Though it is not related to CRP, the book connects strongly to the human-induced climate crisis.

The slideshow uses copyrighted images from sources such as Getty Images, so for this and other reasons, the presentation is not recorded and the charts are not available, but Mr. Gore has appeared in TED talks and other venues online with similar presentations, and those online recordings are available to the public. The charts presented asked, "Must we change?" The next section asked, "Can we change?" The last section asked, "Will we change?" The answer is yes each time.

Mr. Yazell notes that the human-induced climate crisis requires urgent action, as stated by the American Geophysical Union (AGU). In fact, that has been updated by the AGU. Their current (2019) title (for their position [statement](#) on climate change) is, "Society Must Address the Growing Climate Crisis Now." The first sentence is, "Immediate and coordinated actions to limit and adapt to human-caused climate change are needed to protect human and ecological health, economic well-being, and global security." It ends with this sentence, "A position statement on climate change was previously adopted by the American Geophysical Union in December 1998; A new version was adopted December 2003; Revised and Reaffirmed December 2007, February 2012, August 2013, November 2019."

AIAA LA-LV Space Architecture Gathering (22 August, 2020)

(Continued from Page 1)

Many of the issues that civil architects tackle routinely in the design and commission of dwellings, some of them unique or specialized, are found in space missions, and in the design and operation of human spacecraft. After painting a broad overview of the sheer vastness of the universe, the unfathomable dynamics and energies involved, and humanity's aspiration to physically interact in it, he mentioned the various paradigms being offered by the new space pioneers and current policies and visions driving humanity's quest to explore and settle other bodies within our puny solar system. One of the prime functions of the Space Architect, he said, is to create concepts, offering alternatives to the client. Architects are synthesis oriented, trained in graphics and visual representation of concepts, and rely on heuristics or rules of thumb learned from experience, to quickly create alternate visions, while engineers have an analytical bend of mind to help ferret out problems and suggest solutions to realize visionary designs. Both skills are needed to create and commission spectacular and successful space missions. In passing, he mentioned a few heuristics, including a corollary of the Parkinson's Law, that projects will drag on and drain resources indefinitely unless planned and executed deftly. He flashed several concept architecture slides that were developed rapidly in the studio at USC to end his introduction.

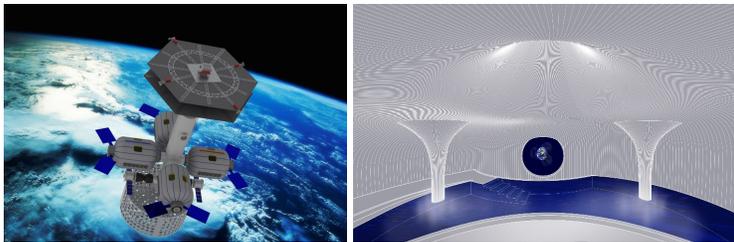


Figure 3,4: Earth Orbiting Hotels can be self sustaining economically if they are coupled with projects like space solar power integration facilities and lunar water production facilities can make cultural facilities like this Moon Bath besides producing fuel and air revitalization. [Credit P. Zarafian USC ASTE527 Studio Viterbi School of Engineering & P. Mungrueagsakul USC Arch599 Space Architecture, USC School of Architecture]

The AIAA has a Space Architecture Technical Committee(SATC – please visit the website <https://spacearchitect.org/>) and Madhu introduced the next speaker, Dr.Olga Bannova who is the current chairperson. Olga is also the Chair of the Sasakawa

Institute of Space Architecture(SICSA) that hosts the graduate program in Space Architecture at the University of Houston, the only program of its kind anywhere in the world. SICSA trains architecture and engineering graduates to enter the world of space activity in general, and human space activity in particular. Olga proceeded to describe the various activities of the SATC within the AIAA, laid out the tenets of Space Architecture and the vital role the discipline plays in human space activity. Olga then presented aspects of the SICSA program. Graduates find employment at NASA and industrial design companies. Anastasia Prošina, a recent graduate of SICSA, then went on to present her ideas on how she is boldly starting up her own practice in Space Architecture. She described some of her thoughts on the subject and showed some of her designs. Delightful to see the new generation visions and proposals.



Figure 5, 6: The extraterrestrial simulator facility and the suitport and rover at the University of North Dakota would provide the facilities for the lunar daylight simulation mission proposed by Marc Cohen. [Credit Marc Cohen, Pablo de Leon, University of North Dakota]

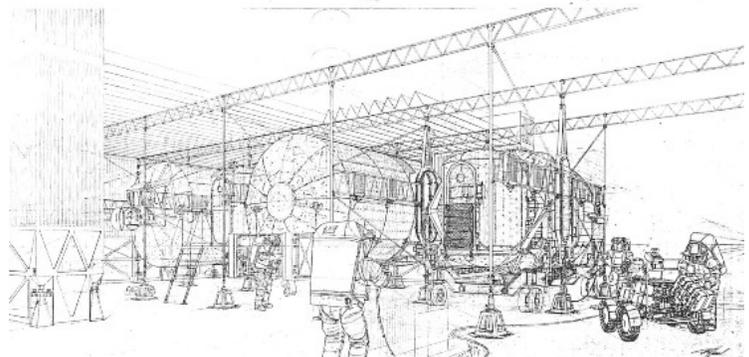


Figure 7: Undeveloped pristine lunar surface presents serious challenges including clingy electrostatic dust and uneven terrain. Jacks and adjustable scaffolding can provide stable, level platforms above the lunar surface to assemble and link modular elements of an extraterrestrial habitat complex. [Credit Brand Griffin]

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Figure 8: This painting by Paul Hudson depicts a concept developed by Brand Griffin to land EVA suited astronauts and cargo together on the lunar surface from lunar orbiting spacecraft. [Credit Brand Griffin, Paul Hudson]

This was followed by Dr. Marc Cohen, a founder of the SATC and long-time NASA space architect. Marc holds several patents including the astronaut EVA suitport and went on to describe how a lunar daylight simulation mission might be designed to study the needs of crew, and presented the simulator and simulation mission his team proposes to conduct by modifying the facility that is already on site at the University of North Dakota (UND). Marc presented the critical rationale for the 14-day simulation – abundant, clean solar energy and power while the sun is shining, of course! He showed various design concepts the group would like to test and measure, including the racetrack design that was developed and debated long ago, during the space station Alpha and Freedom design phase, that preceded the International Space Station. Please watch the video to appreciate how space architects carefully develop programmatic content.

The next presentation was by Brand Griffin, another space architect from the very early days of this discipline. Brand worked for Boeing while the space station was being developed, where he was known as the “chief configurator”, since the term “space architect” had not been invented at that time. He presented various concepts for lunar surface activities and delighted us with both with his beautifully hand-drawn sketches (Brand is a Rome Prize winner of yore, a prestigious award for talented scholars in the Arts and Architecture) and some handsomely finished visionary

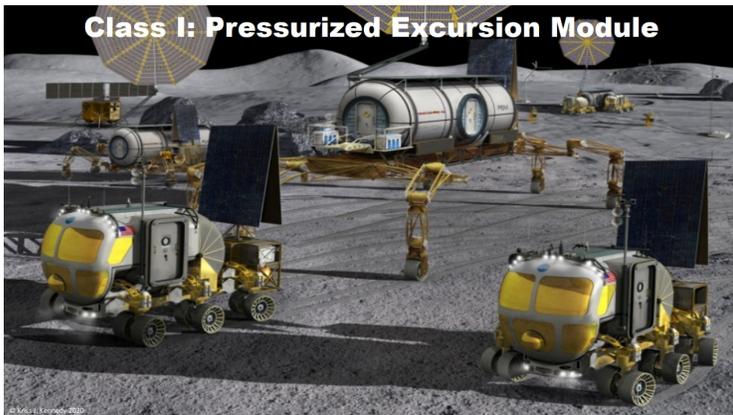
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concept renderings done by Paul Hudson, artist extraordinaire. Fine realist artists are just that. They pay attention to fine detail. Someone in the audience posed a question on the thread I noted. What is the difference between a space architect and a systems engineer? Architects are better trained and more comfortable to handle “wicked problem” solving, where parameters are in flux all the time and not “set in stone”, while searching for practical solutions. Oh, well, systems engineers do that too. One other thing: Architects are very graphic, and their concepts are highly visual in the way they depict visions. Architecture School education trains them that way.

Kriss Kennedy, recently retired after decades of exemplary service at NASA JSC was next. Kriss was instrumental in realizing and testing the inflatable habitat concept called the TransHab, a technology adopted by Bigelow Aerospace, an incarnation of which is attached to the ISS as the BEAM module. Kriss who is also a SICA alumna and now teaches there. He went on to show us some of his designs, including bold schematics for a lunar lava tube habitat, something that showed the power of conceptual design thinking and visualization, something that space architects do quickly, to begin group debate and discussion.



Class I: Pressurized Excursion Module
 Figure 9: Mobility is key to the design and development of any extraterrestrial activity. A version of the NASA pressurized excursion rover is seen towing a habitation module from the landing zone to the habitat site. [credit NASA, Kriss Kennedy]

Dr. Scott Howe of NASA JPL was next. Scott holds advanced degrees in Architecture and Industrial Design. He presented some lunar surface habitat concepts he and his group have been working on. These included use of a

variety of robotic technologies for building structures on the Moon, and methods to move large habitat modules from the lander to the site, for buildup and commission of the lunar surface habitat complex. The six-legged Athlete rover was discussed.

Both Kriss and Scott were instrumental in several simulation projects including building and testing the Deep Space Habitat(DSH) facility during the NASA Research and Technology Studies(DRATS) at the Black Point Lava Flow in Arizona that USC faculty were invited to visit.

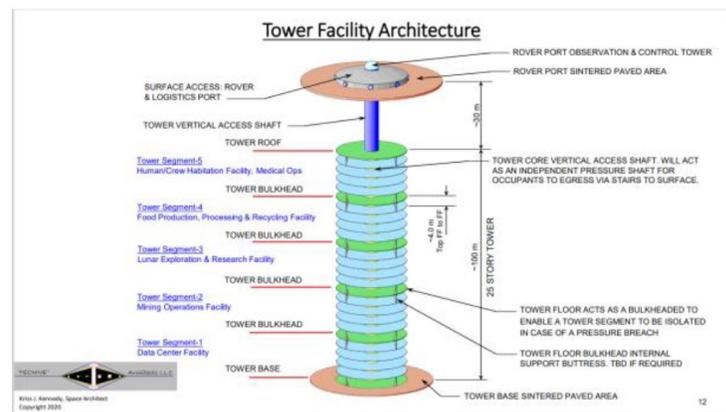
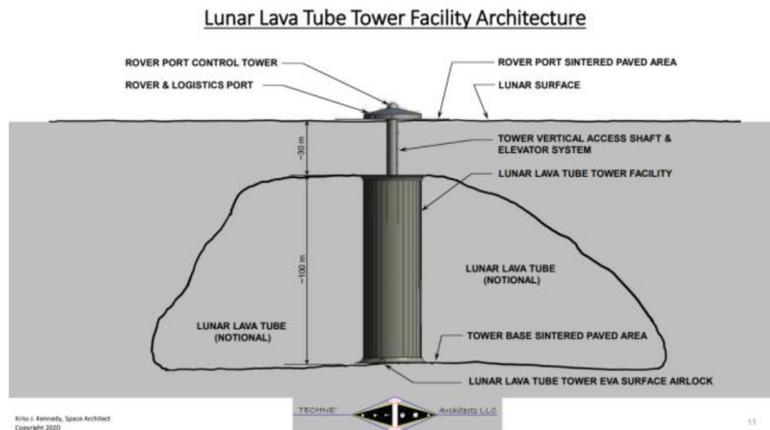
John Mankins, a NASA veteran of many years, originator of the Technology Readiness Level(TRL) concept, proponent of space-based solar power and the Vice President of the Moon Village Association(MVA) presented an overview of the global effort to return to the Moon. He showed the various nations involved in current lunar missions, how the number of nations involved in lunar missions have grown in recent years, and how the MVA is helping to shape a collective and synergetic framework through peaceful and progressive global collaboration, not only among established spacefaring nations but also by inviting many nations with emerging space activities. Fascinating to see how best practices input from MVA are being adopted by NASA and various space agencies around the globe. John also projected some space architecture visions for lunar surface habitats and activities that pointed to the need to carefully study aspects of transport in pristine, natural, rugged lunar terrain. He presented the Habot concept that addressed landing and consolidation of elements in rough extraterrestrial terrain.

Dr. Barbara Imhof dialed in from Vienna in Europe(really !) to present studies and to-scale designs commissioned by the European Space Agency, including the deployment and operations of the Self Deployable Habitat for Extreme Environments (SHEE) compact deployable habitats and showed the workings of the EDEN agriculture module in the Antarctica. Watch those spectacular slides to see how space architects are informing both the mission designers and the public alike, about life and future work at the final frontier.

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Class III: Lunar Lava Tube Tower Facility Architecture

Client: United Space Structures

Vision: Providing habitation capabilities to enable a space commerce to thrive in support of human exploration and resource consumption to become Earth-independent while establishing permanent sustainable human presence on the Moon and Mars.

Mission: Design and development of a Planetary Architecture capability that enables a thriving space economy to support humans working and living on the Moon within a decade while establishing a permanent presence on the Moon and enabling humanity to become a multi-planet species.



Figures 10,11,12: Ideation, Conception, Program Development and Graphic Depiction of Vision are among the highlights of the space architecture professional and their education. It greatly helps the engineering community to explore choices quickly to realize missions in a speedy manner. In these images above, Kriss depicts schematics and vision for a lunar lava tube facility. [Credit Kriss Kennedy]

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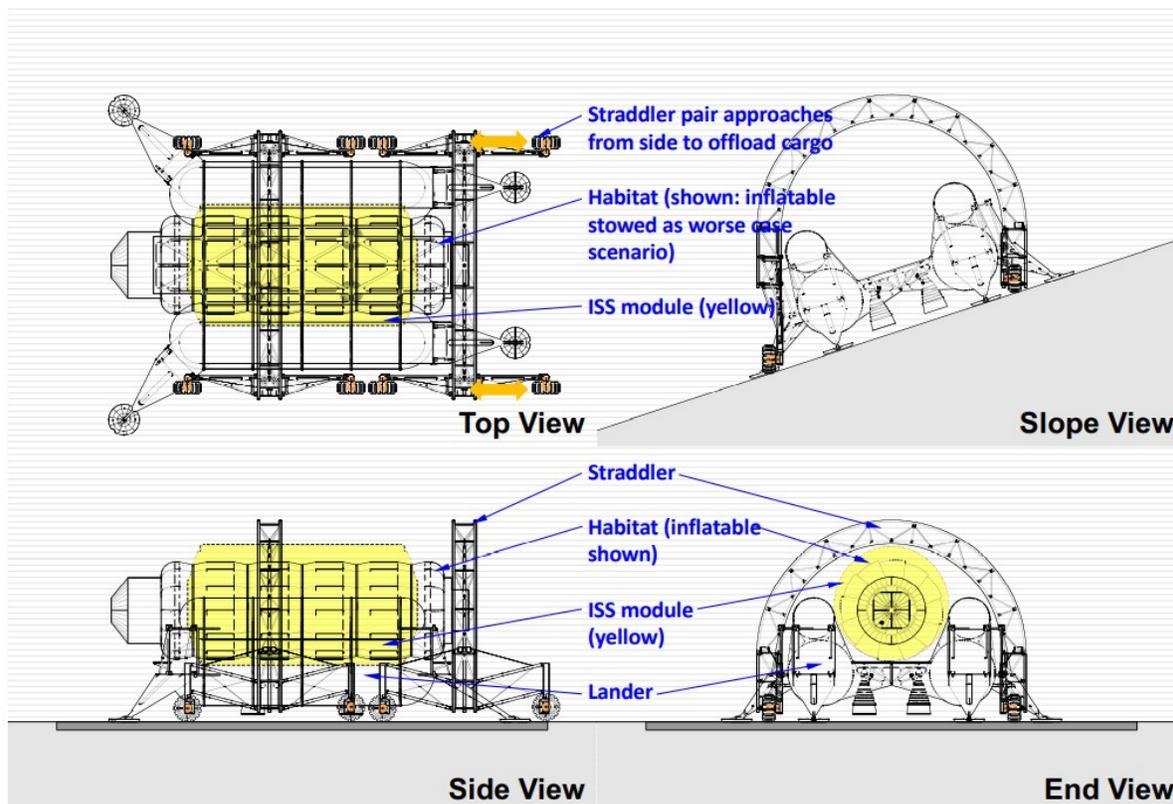
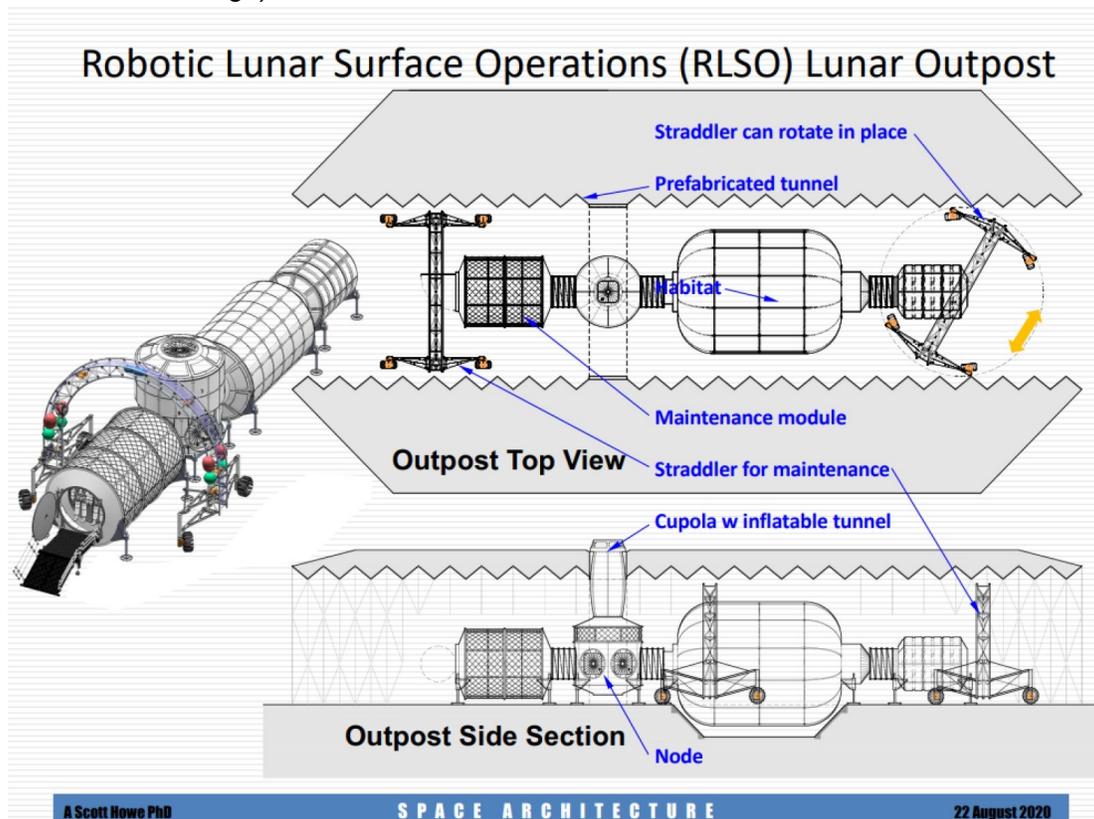


Figure 13a,b: Figure 13 a,b : RLSO concept proposes extensive Robotic technologies be used to assemble modules and set up extraterrestrial habitation, minimizing risky EVA by crew. [Credit Scott Howe, NASA JPL team] (Continued on the Next Page)

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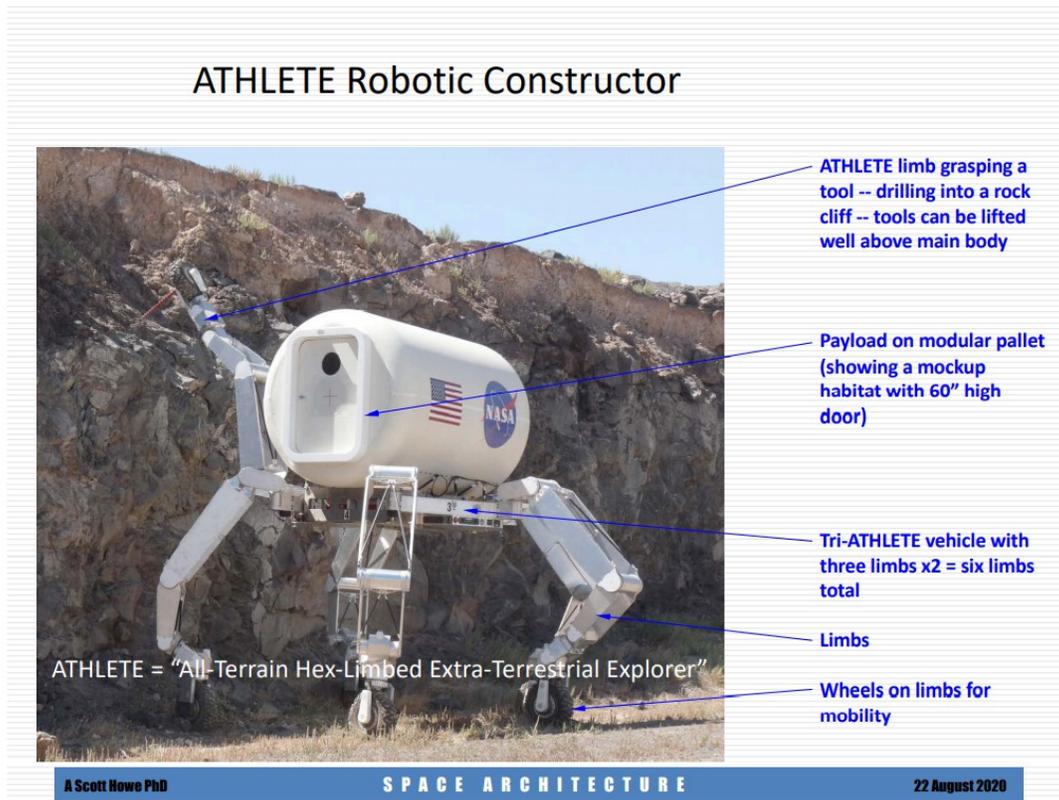


Figure 14: The ATHLETE hexapod mobile robot is a versatile system that can be used for a variety of robotic extraterrestrial infrastructure development projects including lander payload handling and habitat module assembly functions. [Credit Scott Howe, Brian Wilcox, NASA JPL]



Figure 15 (16,17 see next page) The Lunar /Mars Habitat Demonstration Unit Simulator was used by NASA in the Desert Research and Technology Studies(DRATS) to develop requirements and metrics for extraterrestrial habitats. [Credit Scott Howe, Kriss Kennedy, NASA]

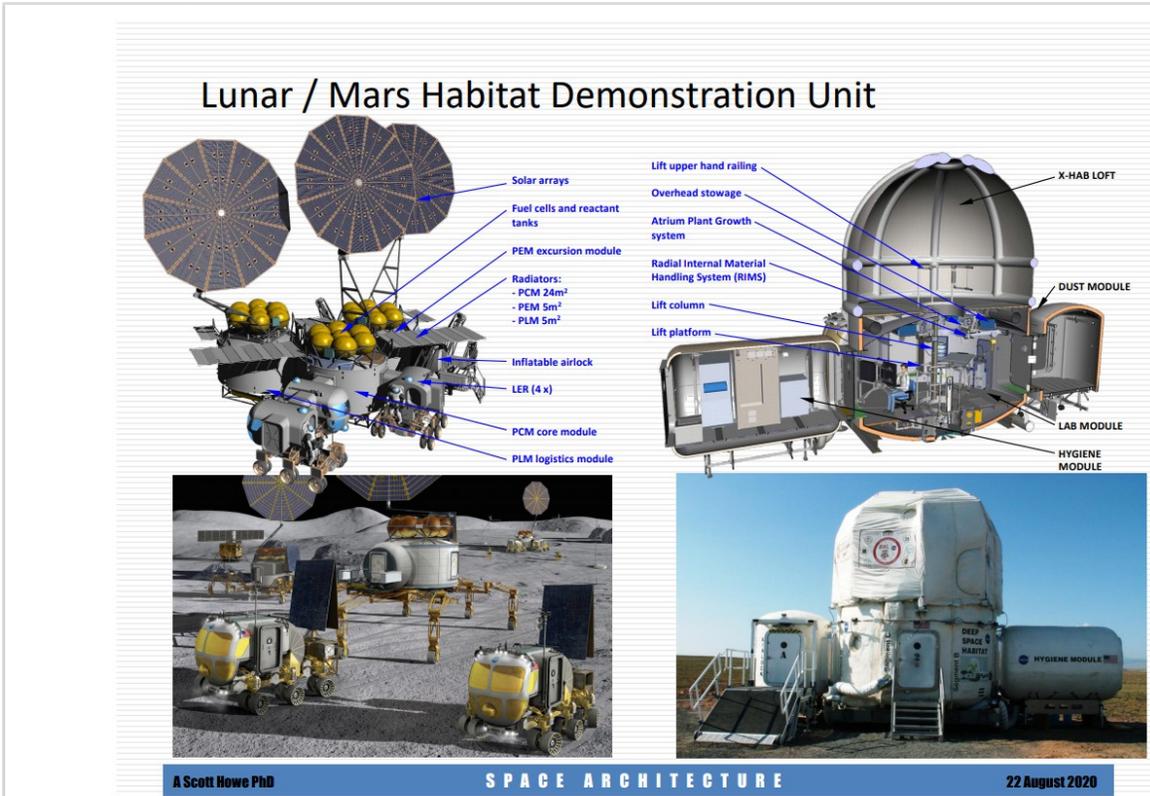
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Figure (15, previous page) 16, 17: The Lunar/Mars Habitat Demonstration Unit Simulator was used by NASA in the Desert Research and



Technology Studies(DRATS) to develop requirements and metrics for extraterrestrial habitats. [Credit Scott Howe, Kriss Kennedy, NASA] (Continued on the Next Page)

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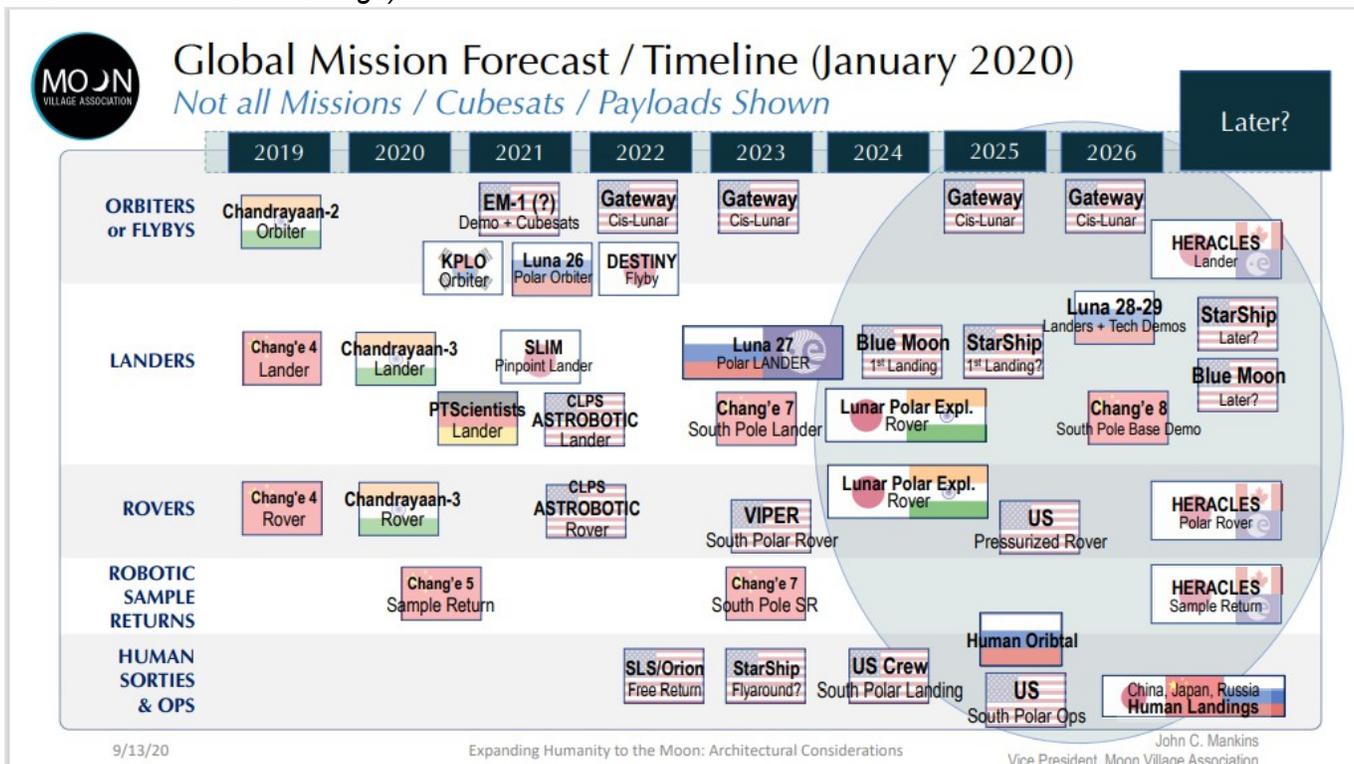


Figure 18: Many nations have plans for lunar missions. The Moon Village Association has several working groups, and John Mankins Vice President of MVA, is coordinating the Space Architecture working group. [Credit John Mankins]

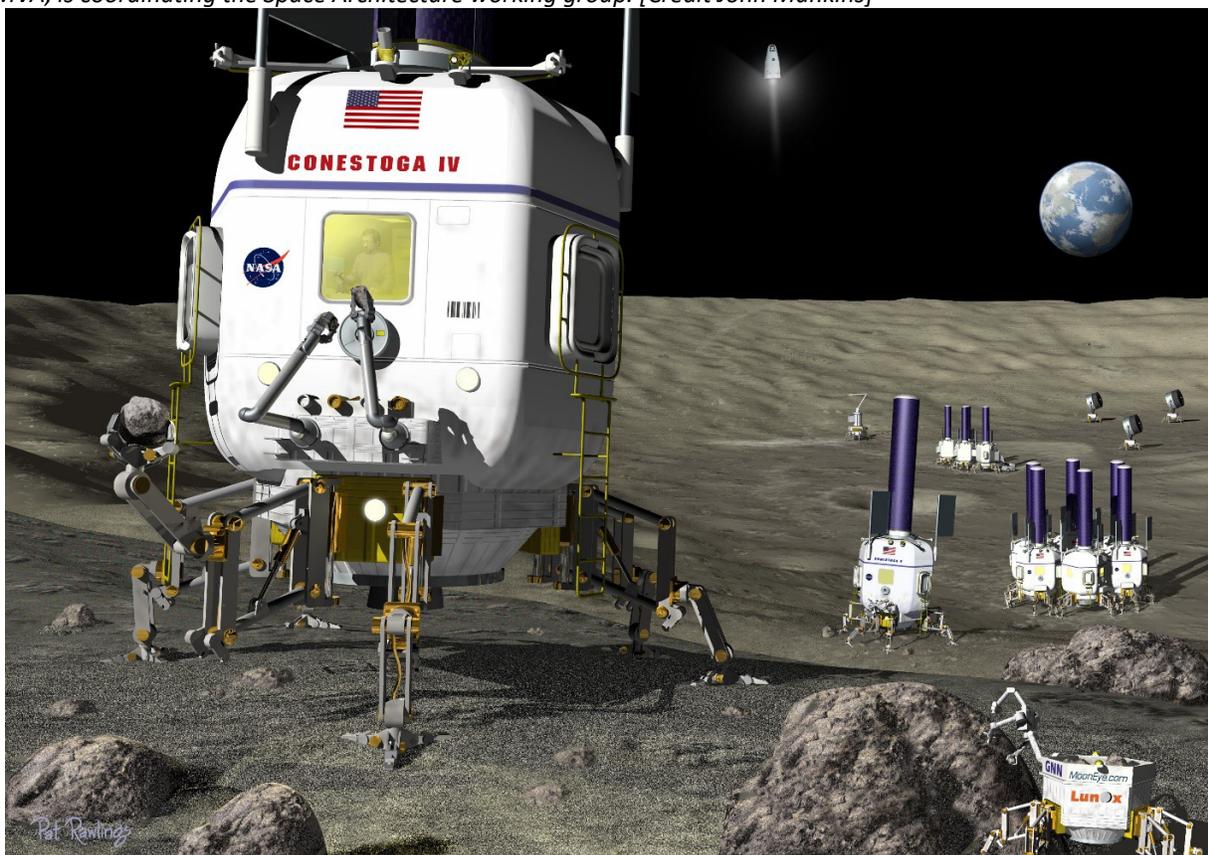


Figure 19: The Habot Concept proposes legged robots for mobility and consolidation of elements in the rugged lunar terrain. [Credit John Mankins, Pat Rawlings] (Continued on the Next Page)

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Figure 20: Simulation run of the Self-Deployable Habitat for Extreme Environments (SHEE). [Credit Barbara Imhof, ESA]

Taking off on simulator design, the next speaker, Barbara Belvisi, dialed in from Paris (Yes, "La Ville-Lumière", the real City of Lights) to inform us of developments that her group is making toward building a habitat simulator in the Mojave. How to minimize the ecological footprint of dwellings and be as self-sufficient for resources and be independent of surroundings? How to create a more ecologically friendly habitat complex that addresses some of the issues we raised at USC in the Space and City seminar regarding use of the best of space technologies to build, evolve and operate self-sustainable habitats? Barbara is teaming with progressive investors to make this happen here in the southland. Self-sustainability, both economically and material resourcewise, means that such a facility would seek to attract paying visitors to occupy premises while research is being conducted in parallel. Tough to do. We wish her well.

The next speaker was none other than John Spencer who is the founder and president of Space Tourism Society. He went on to discuss how space tourism is the low hanging fruit that is about to change the entire human spaceflight industry that is eager to generate revenue in an endeavor that has mostly been funded by governments since the dawn of the space age. This dependence on government is slowly but surely changing. He went on to compare the ocean cruise lines business and showed the orbital yacht concept that he hopes will close the revenue loop for a lucrative business case. John is also chief designer for an Earth-based Mars World simulator that he hopes to build soon.



Figure 21, 22: EDEN ISS Project in the Antarctica continues to produce fresh greens for south pole researchers. [Credit ESA]



Figure 23: Interstellar Lab proposes a Mojave Simulator to use the best of space technologies to build, evolve and operate a self-sustainable habitat. [Credit Interstellar Lab and Barbara Belvisi]

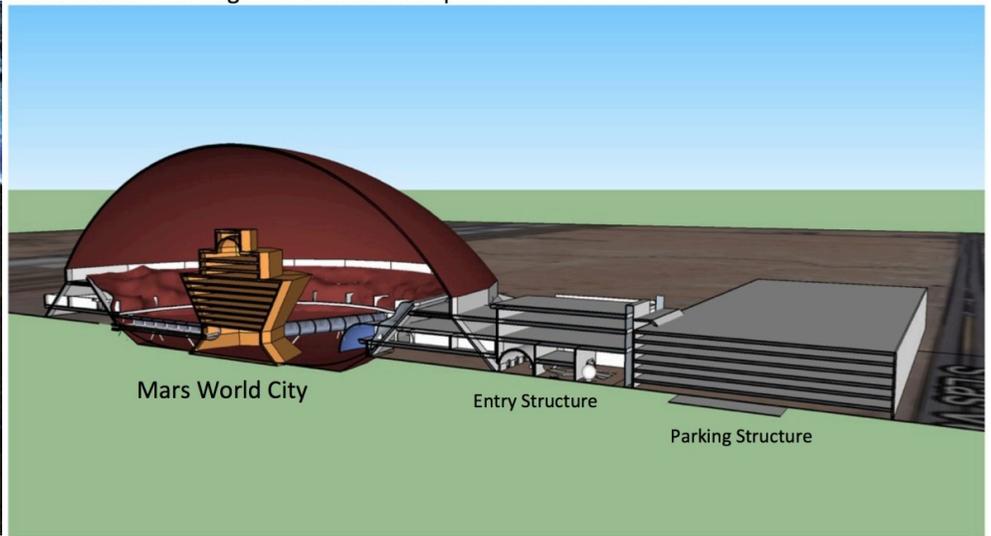
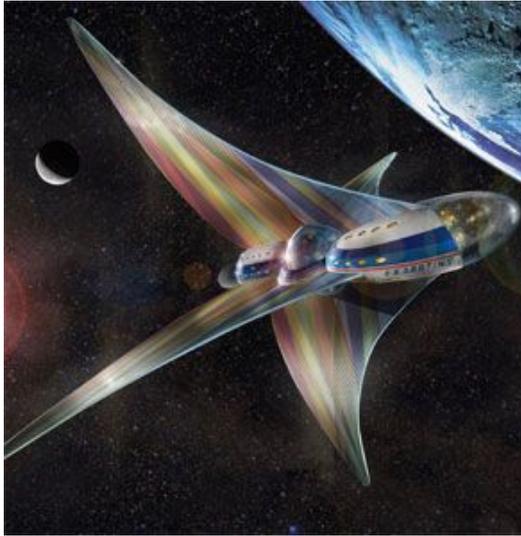
Award winning space architecture practitioner Melodie Yashar was on next to present her award winning Mars Habitat design. She went on to elaborate how NASA's Centennial Challenges has been evolving their rapidly growing program, leading to phased competitions, advancing robotic building technologies, especially 3D printing of habitats using in situ resource utilization also known in the field by the acronym ISRU. This is a critical technology for space exploration especially for extraterrestrial infrastructure in order to reduce the mass and cost of materials that would otherwise need to be flown in. This is also a rapidly evolving technology that is already seeing application here on Earth, both in the building of advanced forward base camps as well as for quickly creating shelters for people affected by natural disasters like earthquakes, fire, hurricanes or even famines, and to help people displaced by man-made calamities like war. Melodie presented her award-winning Mars Habitat design that is seen below. Mars Forward vision clearly could use 3D printing technology but Moon Now visions may also use much of the vital technology to lay down essential infrastructure.

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Mars World™ Las Vegas Destination Complex



Cross Section Through the Entire Mars World™ Complex
© September 2015 – Mars World Enterprises, Inc. (MWE)

Figure 24: Orbital Space Yacht and Mars World Complex are the visions of John Spencer who models his designs after the luxury cruise lines hospitality business. [John Spencer & Space Tourism Society]



Figure 25. Melodie Yashar’s NASA Centennial Challenges award winning Space Architecture for an evolved Mars-X House Habitat. [Credit: Melodie Yashar]

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Finally, Dr. Jack Stuster, anthropologist and professional ergonomist of many years and several deep research studies for NASA and a book devoted to the subject of long duration missions laid out in stark terms what can happen if we do not prepare carefully for such an endeavor. We could have listened to Jack forever about flight crew experiences and anomalies, but time had run out and we had to move on to panel discussion.

To pique the minds and to prod the panel, Madhu projected a few more slides in which he tried to present the impetus provided by the current administration to the nation's space program and human spaceflight through the various space policy directives and the most recent White House/National Space Council report titled "A New Era for Deep Space Exploration and Development" that laid out the foundation for future human space activity, highlighting collaboration of various governmental agencies, commercial and international actors. Madhu mentioned a less known, less than spiritual "Golden Rule" heuristic that may be changing guard for true space commerce to blossom, as the private space industry gains teeth and muscle. A hearty panel discussion about spacesuit design by panelists was followed by several questions from the audience who numbered about 140. A good time was had by all and posted recordings show the continuing interest in the discipline called Space Architecture.

Last but not the least, many thanks to AIAA LA/LV Section Chair Dr. Sonwane and Events Organizer / Program Chair Dr. Ken Lui for working the details and following through with all the communications and AIAA forms that go with such events.

AIAA LA-LV is planning another event on Saturday December 19th, for those who wish to tune in to the next online edition of the Space Architecture Gathering during Christmas and holiday season from the southland section of the AIAA.

Please visit the Space Architecture Technical Committee (SATC) website

<https://spacearchitect.org/>

to become familiar with what Space Architecture professionals and academics are involved in. Also enjoy the bibliography that is continually updated with projects and papers that Space Architects present at various venues and publish.

The USC Astronautical Engineering ASTE527 Space Concepts Synthesis Studio projects may be accessed at :

<https://sites.google.com/a/usc.edu/aste527/home>

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Mirpuri Foundation sponsors AIAA SATC Awards

The Mirpuri Foundation is happy to announce its sponsorship of the American Institute of Aeronautics and Astronautics' (AIAA) Space Architecture Technical Committee Awards.

Advancing aeronautical research is one of the founding pillars of the Mirpuri Foundation, while the AIAA, which has over 30,000 members worldwide, is a professional society for aerospace engineers. It is also the US representative on the International Astronautical Federation and the International Council of the Aeronautical Sciences.

The Mirpuri Foundation now announces a collaboration with the AIAA annual Space Architecture Technical Committee Awards, providing a grant for the best professional paper as well as for the best student award.

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Figure 26 : SATC members and colleagues gather at various conferences. This photo was shot after a SATC dinner at Parker's Light House in Long Beach California, following the AIAA Space Conference Exposition Conference, 2011. Several of them presented at the August 2020 Space Architecture gathering. [Credit Madhu Thangavelu]

CLFA *(Continued from Page 2)*

CLFA, that is FRACAS in a repair depot, seeks to “close the loop” between the failure noted and the repair made. In its most basic form, it does this by asking the question as to whether the part ultimately replaced can logically be connected to the field failure.

Why must CLFA be instituted? Won't the repair depot automatically do this?

No. An affordable repair depot works to increase throughput while keeping costs down. Diagnosis is performed only to the extent needed to ensure a successful repair as judged by final acceptance test metrics. Large depots can contain many shops that perform their work somewhat independently of each other. A subsystem might be delivered to the depot and have a component removed and replaced and the subsystem is tested and sent out again. Meanwhile, the component may have a part removed and replaced and then the component is tested and placed on a shelf as a good spare. It is easy to ship bad actors back out to the field all the while your final acceptance tests look pretty good.

Have you ever tried to get something fixed, only to find it works OK when you show it to your repairman? Intermittent failures can cycle between depot and field, lowering field reliability rates while depot metrics seem OK.

Don't get me wrong, the very affordable remove and replace strategy is a good one for speed, throughput, and efficient repair. But unfortunately, it has the potential to allow failed parts or components to remain in service and for emerging failure modes (those not thought of during design) to remain undetected.

Good and great sustainment organizations will enter into agreements with their depots to ensure repairs are traced back to failures and sufficient diagnostics are performed to ensure emerging failure modes are found.

What is sufficient? The more you do, the more you drive up your costs. Controls are appropriate.

Under CLFA, even if your program starts with 100% screening, it can quickly eliminate from scrutiny those failure modes and repairs that are well known or become well known after CLFA has functioned for a few years. For instance, you need not do a post mortem dissection on a faulty part with a well-known failure mechanism history.

On the other hand, a mature CLFA program will not limit its investigations to only weapon system operational failures. Subsystems and components can and do fail in the depot and elsewhere, revealing important weapon system assessment data concerning emerging failure modes. A mature CLFA program will also take the findings of its failure review board and use them to improve its own depot processes and equipment.

CLFA demands good processes and a good information management system to handle the large amounts of data generated and analyzed. These processes and data systems are also subject to improvements based on CLFA data.

Even with all these benefits to the depot itself, it is the sustainment organization that should step up and pay to start and continue CLFA at its depots. The diagnostic information is a key part of the “Observe System” step in the CSSMM we have been discussing in these articles.

Air Force Is Conning the Ship *(Continued from Page 3)*

A joint warfighter... 10 cats and traps on 8 carriers! A story of Lt. Col. Mark Hasara's last trip to the carrier at sea, right after Operation ANACONDA in April 2002.



Viking Kennedy

“Where are you going, and who approved this trip, Sluggo?” Conan asked, smiling.

“Bahrain, and then on a COD to the USS *John F. Kennedy* in The Indian Ocean. I’m discussing their move up into the NAG and getting their Anaconda lessons learned so we don’t make the same mistakes over Iraq.”

Conan told me to have a great trip, gathered up the brief, and stepped off to his next appointments.

The USS *John F. Kennedy* was about to transit from the Indian Ocean through the Strait of Hormuz and into the Northern Arabian Gulf to begin Operation Southern Watch no-fly zone support. My team needed to gather Carrier Air Wing 7’s lessons learned while they were still fresh in their minds and to brief them on current and future Iraq refueling operations. Rolls, one of the Navy folks in San Diego I worked with at the KC-135 Employment School, was now the Carrier Air Wing 7 chief of plans. Even in combat, it’s not always what you know but who you know. Two days after I sent Rolls an e-mail about my travel plans, he e-mailed back the air wing had approved the visit. I do not know of any aviation-related event on the face of this planet compared to blue water Navy aircraft carrier operations in combat conditions. Every jet catapults at max gross weight carrying live weapons. General Scott said Afghanistan schedules were relatively static at the moment, so it was a good time to go see Rolls. Chunks, a good friend of mine in the States, sent me a new lunch bag filled with sixty rolls of Fujichrome Velvia 50 film just for this trip. I packed a light carry-on bag and my new Minolta camera.

A loadmaster escorted me to the C-130’s cockpit for the hour-long flight to Bahrain. I talked with the flight crew for the

entire hour about their airlift operations and their thoughts on going into Iraq. Folks working in the CAOC’s Naval Air Liaison Element, or NALE, said the only hotel to stay at in Manama, Bahrain, was the Ritz-Carlton, right on the beach. Being a very light sleeper from my SAC nuclear alert days, I just wanted one good night’s sleep without jet noise waking me up. As I walked into the Ritz-Carlton lobby, I saw the NALE folks had not steered me wrong. My room on the sixth floor was silent—no planes departing nearby in afterburner. I was in bed by 2000 and slept for eleven hours. A taxi dropped me off at Manama’s Navy Air Traffic Office the next morning. Four Grumman C-2 Greyhounds were parked behind the fence, all with red-and-orange sunset tails with a silhouette of a cowboy on a horse, the insignia of the VRC-40 Rawhides.

Leaving Manama at 0900, I settled in for the three-hour flight to the USS *John F. Kennedy*’s flight deck. Somehow my Navy counterparts could sleep in the back of the noisy COD, but I could not. As we approached the *John F. Kennedy*, the loadmaster began giving the same instructions I’d heard multiple times when approaching carriers for trap landings: feet and knees together, arms crossed and hands grabbing each shoulder harness firmly, chin down on my chest. We broke at 3 g’s over the bow, and I could see Big John’s wake under us. My grip on the shoulder harness tightened. After another loud SCREECH—BANG—HALT, I was back aboard the *Kennedy*, which was steaming in combat conditions. As we taxied out of the wires, the loadmaster dropped the cargo ramp. Hornets and Prowlers lined both sides of the bow. Two Hornets taxied behind us toward the waist catapults. Burning jet fuel is like crack in the nostrils of a military pilot, and *Kennedy*’s deck reeked of it. When we reached the hummer hole, the COD’s props reversed thrust and backed us into a parking space in front of the conning tower. Rolls stood behind the COD’s cargo ramp, waiting for me. A few moments later, the engines shut down.

Over the loudspeaker, I heard “Lieutenant Colonel, United States Air Force, arriving!” Field-grade officers with ranks of O-5 and above are rendered honors when coming aboard a Navy vessel. I thanked Rolls for the Navy’s formal greeting. “Captain Bill Gortney and Air Wing Seven welcome you aboard, Sluggo!”

“Rolls, thanks so much for letting me come down. We have a lot to talk about.”

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Air Force Is Conning the Ship *(Continued from the Previous Page)*

A joint warfighter... 10 cats and traps on 8 carriers! A story of Lt. Col. Mark Hasara's last trip to the carrier at sea, right after Operation ANACONDA in April 2002.

As we walked down the catwalks belowdecks, Rolls and I discussed what was going on in Afghanistan. After signing in at the *Kennedy's* ATO office, Rolls walked me to the carrier's billeting manager's office. Lieutenant colonels get their own staterooms, which cost \$35 a day for meals and incidentals. Anyone would pay ten times that amount to be where I was and to see the activity on the flight deck. Carrier Air Wing operations were the Valhalla aviation photographers dreamed about. After we dropped my bags in my room, Rolls walked me down to the CVIC. He introduced me to his staff, and I shook hands with Rolls's planners and intel analysts.

If you're on a carrier, the CVIC is the place to hang out. It's the nerve center for air operations, intelligence on enemy forces, analyses of targets and future operations, and the air wing schedule. Everyone had questions about air refueling during Anaconda, and Rolls scheduled a meeting for me to talk with his staff later that day. Our next stop was a short introduction to the commander of Carrier Air Wing 7. Captain Bill Gortney the Air Wing commander, call sign Shortney, discussing refueling over Afghanistan, and answered my questions about his move to the NAG. His air wing pilots had great praise for the tanker operations in Anaconda; they were "the best we have ever seen," he said. Rolls had strike plans to create, so he left me to my own devices, handing me his phone and bulkhead numbers if I got lost between decks. Fortunately, having been on carriers before, I knew my way around. Bulkheads and their numbers were something most Air Force people just smacked their heads on. But bulkhead numbers are a map to the carrier belowdecks, and I understood what to do when someone told me to find him or her at a particular number.

I walked aft, headed for the air wing ready rooms. Aircraft recovered one deck above my head, with the same *SCREECH—BANG—HALT* of my COD arrival. The sound of the arresting cables reeling out filled my ears as I walked through the door into the VF-143 Pukin' Dogs' ready room. A few F-14 Tomcat aircrew members stopped what they were doing and looked up at me; not a lot of Air Force lieutenant colonels visited the ready rooms.

The duty officer sitting behind a desk asked, "May I help you . . . sir?"

Every head turned to see who the "sir" was. I introduced myself as chief of the ARCT from the Prince Sultan CAOC, the guy who de- signed Anaconda's refueling plan. Everyone gathered around me at the duty desk. Some related how refueling had gone well, and a few others told me some things ARCT needed to change. Softer drogue baskets was a common theme, and I told them wing pods were coming soon. Others had questions about how big-wing tankers operated. In every business, the best learning tool has always been a long

talk with your customers, and there I was surrounded by them. Pukin' Dogs Tomcats could not do their job unless they were refueled by Air Force or RAF tankers. Very few Pukin' Dog aircrews understood tanker planning and the math used to build a schedule. Ollie, the Pukin' Dogs' commander, asked if I could come back and talk to his junior officers and discuss tanker capabilities. All of his JOs' first hookups behind Stratobladders and Gucci Birds had been under combat conditions over Afghanistan, a terrible way to learn the Iron Maiden's foibles.

My next stop was the VFA-11 Red Rippers ready room. Lungs, the Red Rippers' skipper, asked if I would give his new Tomcat crews a briefing on tanker capabilities and limitations. I was beginning to notice a trend here. Lungs told me the same thing Ollie had, that most of his JOs refueled off Air Force tankers for the first time over Afghanistan in combat. What would happen if a Coalition air force went into Iraq? Trim, skipper of the VFA-131 Wildcats, and his executive officer, Satan, had a lengthy discussion with me about tanking over Afghanistan. I took notes as fast as my right hand could fly in a black-and-white composition book I'd bought for this occasion. I still have that composition book. I wanted to find out how the Lockheed S-3 Vikings of the VS-31 Topcats accomplished air refueling at sea. When I walked into their ready room, everyone noticed the Air Force lieutenant colonel and wondered how I got there. Pecker, the Topcats' skipper, had a meeting to run to but assured me he would hook me up with one of his pilots later on.

I met Rolls back in the CVIC, and his planners walked me through their goods and not-so-goods of Anaconda. I laid out the initial Anaconda refueling plan and explained how it had been overcome by events on the ground. They all understood the strain put on us by Petty Officer Neal Roberts's falling off RAZOR 03. This discussion evolved into refueling operations for Southern Watch and what would happen if we went into Iraq again. Knowing SPEAR probably had good reports on Iraq's Air Force and integrated air defense network, I asked to read their latest. It was a gold mine of information. After a quick swing by the Dirty Shirt Mess for a couple of sliders and some auto dawg, I slipped into bed at 2330, tired and pleased. Our Navy customers were really happy with how my refueling team had supported them, but the lack of drogues in a theater was detrimental to Carrier Air Wing 7's ability to get gas and stay up longer, particularly if the US went into Iraq soon. I dropped my composition book on the floor beside me and rolled over to get some sleep. The clock said 0017. I always sleep well aboard a carrier at sea. Big John rocked me to sleep, and continued rolling all night long. Best night's sleep I'd had in a long time. The carrier's motion gently rocks you to sleep.

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Air Force Is Conning the Ship *(Continued from the Previous Page)*

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USS Seattle

The next morning I was back in Lung's Red Ripper ready room drawing my tanker capabilities and limitations briefing on his presentation whiteboards. I drew a big picture of the Iron Maiden basket, with big teeth in the center and beady red eyes. A sliding whiteboard covered the Iron Maiden picture with training objectives and an outline. I asked the Ripper crews what they thought of the Iron Maiden, and most of their answers I cannot write here in a family-oriented book. I then slid back the panel covering my toothy Iron Maiden picture, and the whole room erupted in laughter. One training point I wanted to stick in their minds, even if they forgot everything else I told them, was that the airflow from the KC-135's big CFM56 turbofan engines calmed down markedly while plugged in the basket if they asked the tanker pilot to pull the inboard engines back. Every KC-135 pilot knew what that meant. Putting the outboard throttles up to compensate for the inboard-engine throttle reduction and loss of inboard thrust meant that the CFM56 engines' hot exhaust gases were not beating on the Tomcats' twin vertical tails. It was the same for the Hornet pilots. Every head in the room went down as they scribbled "pull the inboards back" on their notepads.

One pilot asked when the KC-135 fleet would get soft-basket wing pods like the KC-10's WARPs. A company in the United States called Cobham expected to test pods in the summer for release in the fall. The Air Force had bought only thirty-three pod sets for the forty-five aircraft retrofitted for MPRS pods. Everyone liked refueling off of the Gucci Bird's WARPs, with their soft, collapsible baskets. One pilot called the Gucci drogue "the Nerf Basket" because of its soft contact. Note to self: find out from AMC Requirements when the MPRS pods were fielding and the health of the WARPs and Iron Maidens in case Iraq's air campaign loomed soon. I sent a message back to Gramps and AMC that night.

Rolls met me in one of the ready rooms and asked if I would like to attend the admiral's battle group staff meeting. Captain Gortney introduced me to the carrier battle group admiral and the entire O-6 staff. The admiral went around the room, speaking with each captain about their responsibilities. Their discussion was a fascinating look at carrier operations at sea. Captain Gunner, in charge of weapons, mentioned that the *Kennedy* would replenish its bomb lockers in a few days, during UNREP. The admiral told Captain Gortney that he wanted me to fly before leaving *John F. Kennedy*. Shortney said he would see to it. I was elated at the possibility of an S-3 Viking hop before leaving. The next day, in his staff meeting, Shortney told Pecker I was cleared to fly.

The Rawhides' C-2 COD broke the next day. I was stuck haze gray and underway for at least three more days. When I met Rolls in the CVIC, he told me the *Kennedy* was scheduled for UNREP that afternoon from the *USS Seattle*. Pulling a ball cap over my head at the appointed time, I walked up several flights of stairs to the bridge. The officer of the deck announced my arrival—"Lieutenant Colonel, US Air Force, on the bridge"—and everyone turned to see me walk in. The same look appeared on everyone's face: "What are you doing here, colonel?" Beyond the control desk and wheel, the auxiliary conning tower was full of people. The aux con is made up of wings off each side of the bridge, about fourteen stories above the water rushing beneath you. Navy officers controlled rendezvous and UNREP with the *Seattle* from the aux con via computer monitors and radios. The *USS Seattle* steamed along half a mile in front of us as the *Kennedy* closed to a position along *Seattle's* left side. A US Coast Guard cutter approached *Seattle* from the right side to fill their tanks with fuel also. Three additional rolls of film jingled in the calf pocket of my flight suit with every step I took.

Half an hour later, the *Kennedy* and the *Seattle* were steaming side-by-side on a glass sea. Men on the *Seattle's* decks shot rope lines across to fuel specialists standing in *Kennedy's* refueling areas on the right side. Big steel cables stretched across the open ocean between the ships, followed by black fuel hoses. Forty minutes after pulling alongside each other, the ships were hooked together and passing fuel, mail, and food. This was refueling of a very different sort. The *Kennedy* took on 1.2 million pounds of jet fuel over the next few hours through six hoses stretching between it and the *Seattle*. A young ammo shop lieutenant steered or "conned" the carrier through hooking up. All three ships—the *Kennedy*, the *Seattle*, and the cutter—glided through the water on a southeasterly heading.

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Air Force Is Conning the Ship *(Continued from the Previous Page)*

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The captain in command of the ship, call sign Harv, sat in his chair behind the lieutenant. Harv asked what an Air Force tanker pilot was doing aboard. I explained that I had come aboard for a few days to visit with each squadron to learn how Anaconda went for them and to teach the JOs about big-wing tanking.

The next lieutenant assigned to conn the ship failed to show up at his appointed time. The officer of the deck called his department to find out his whereabouts. He wasn't coming because of something that was happening in his department. Harv, in a moment of insanity, looked at me and said, "Hop in there, Sluggo, conn the ship."

"Sir . . . with all due respect, are you nuts?!" I said.

Harv's UNREP staff chuckled quizzically, as if to say, "Yes, boss—you are joking, right?"

Harv wasn't joking.

"Sluggo, it's just like flying formation in your tanker. The only difference is anticipating rudder and screw inputs. Make one-degree heading changes at the helm, and only one-percent RPM changes on the inboard screws. Keep the two outboard screws at seventy percent RPM. Maintain eighteen knots speed and a two-hundred-twenty-five-degree heading on the computer monitor. The one-eighty stick on the Christmas tree there outside the window stays on *Seattle's* waterline. Piece of cake, Sluggo."

I thought, *Sure, why not.* Outside the window below me, I could see the Christmas tree Harv was referring to; it was made of PVC pipe and stuck outward toward the *Seattle's* waterline. Branches started at 130, climbing in increments of one hundred up to 230 feet. Harv had told me to keep *Seattle's* waterline on the 180 limb, maintaining 180 feet of separation between ships. Yes, America, the largest Navy ship—one hundred thousand tons of steel aircraft carrier—maintains formation and separation with PVC pipe. A stripe on *Seattle's* side helped me keep position fore and aft. A single CH-46 Sea Knight helicopter used a sling to carry food and palletized bombs onto *Kennedy's* deck. The Sea Knight appeared motionless above the *Seattle's* rear deck, even though the ship was moving at eighteen knots, while merchant seamen attached bundles to the hooks under the fuselage. Two SH-60s from Carrier Air Wing 7's Helicopter Sea Combat Squadron 5 Nightdippers slung smaller bundles from the *Seattle* to the *Kennedy* beneath their fuselages. Harv's crew in the aux con coordinated with *Seattle's* crew in their aux con ahead of us.

Harv, in another temporary loss of situational awareness, radioed *Seattle's* captain. Through my headset, I heard Harv ask, "Hey, Iggy, are you sitting down?"

Iggy replied, "Why, should I be?"

Harv shot back, "*Air Force is conning the ship!*"

All seven heads in *Seattle's* aux con turned in unison. One officer held binoculars up to his eyes and pointed at me with his right hand. So I waved back. I don't know of another Air Force pilot who can say he or she conned an aircraft carrier taking on fuel. In the fifty minutes the *Kennedy* spent next to the *Seattle*, 420,000 pounds of jet fuel passed into *Kennedy's* tanks. How's that for a big gulp?

The *Kennedy* slowly crept aft, getting heavier as the *Seattle* became lighter from pumping its gas through the hoses. Standard refueling technique as receivers gained weight was to push the throttles up to maintain speed. Over my headset, I told the young helmswoman, "Helm, make your RPMs seventy-one percent."

A young African-American woman from Alabama reported back, "Aye, aye, sir, making my RPMs seventy-one percent." Iggy called over, "Hey, Sluggo, what do you do in the Air Force?"

"Sir, I'm a KC-135 pilot and currently chief of the Air Refueling Control Team at the Prince Sultan Air Base CAOC. My team manages air refueling for all four Coalition countries' tankers."

After a lengthy pause, Iggy said, "We love tanker guys!" Harv's entire crew busted out laughing. Iggy was an F-18 Hornet pilot, so of course, he loved tanker guys and gals. Hornets were the fuel-critical fighter in every Carrier Air Wing, holding little and burning a lot. Legacy Hornets held nine thousand pounds of internal fuel and burned it at the same rate Eagles do, eight thousand pounds an hour at tactical speeds. Understand the problem? Most Hornets flew with two external tanks, one on the centerline and another on a wing pylon, in a configuration nicknamed "goofy gas." Hornets had to use Air Force big-wing tankers on every strike mission Afghanistan support called for. The VFA-131 Wildcats and VFA-136 Knighthawks on the *Kennedy* consumed a lot of gas, so Iggy's "We love tanker guys" reply did not surprise me.

Fifty minutes later, another Navy lieutenant reported to the aux con to drive. Conning the ship was a training item junior officers needed to accomplish for mission certification at sea. I did not want to leave, because the *Seattle* and the *Kennedy* would remain tied together for another three hours. I handed the lieutenant the neck mic and stood next to Harv in his aux con captain's chair, discussing events in Afghanistan and Iraq and watching the sunset and all the ship lights come on. A big half-moon reflected off the ocean behind *Seattle*. Who would want to leave a picture like this?

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Air Force Is Conning the Ship *(Continued from the Previous Page)*

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Friday 29 March was my last day haze gray and underway. I walked into the VS-31 ready room to see that Pecker's Topcat schedulers had my name on their flying board. My Viking ride would last about two and a half hours, followed by a trap landing back on Big John, running to the Topcats' personal equipment room, getting out of all my flight gear, running upstairs to the ATO office to sign out, and hopping onto a COD back to Bahrain. Friday would be a long day, and I had eighteen rolls of film out of the original sixty left. Another cat shot—the first of two in one day, and my tenth overall—happened just before official sunrise at 0633. By regulation, I could not sit in the copilot/tactical co-ordinator, or COTAC, seat during a cat shot before official sunrise for safety reasons. TOPCAT 706's takeoff time was ten minutes before official sunrise. With three of us on board, I would switch places with the COTAC once we were airborne.

A survival equipment specialist in the Topcats' PE room fitted me with flight gear: a survival vest, an oxygen mask, and a helmet. Petty Officer Reynolds briefed me on arming and disarming the ejection seat. Stick, the S-3 instructor pilot I was flying with, met me in the PE room. He reviewed all the mission specifics with me and a tactical co-ordinator, or TACCO, call sign Red Man. TOPCAT 706 would launch with TOPCAT 702, refueling the surface CAP above the *Kennedy* and then descending to 1,500 feet to tag ships in the carrier's vicinity. JFK's surface combat air patrol (SUCAP) orbited near the carrier at eighteen thousand feet, an additional protective cover for the battle group. Orbiting above recovering aircraft, or "hawking," TOPCAT 706 would act as a tanker for aircraft with emergencies during recovery. Stick briefed me on his ejection criteria. The most common reason for ejecting was a weak catapult stroke. He warned me not to get run over by the carrier after landing in the water so I would need to steer away from the ship's forward movement. Stick emphasized that I shouldn't touch the big yellow ejection ring between my knees unless we talked about it first or he told me to eject.

I didn't want to blast through Plexiglas at 1,500 feet, watch a parachute canopy bloom above me, and splash down into the Indian Ocean to wait for someone to pick me up, hopefully a friendly. The last items Stick briefed me on were the defensive maneuvers we would undertake if we came under fire from an enemy ship. Fortunately, he had never been fired at while tagging ships around the carrier.

Crouching down to get through the Viking's small entry hatch, I moved to the TACCO's ejection seat in the back of the jet. I buckled my survival gear to the ejection seat pan and fastened

my lap and shoulder harnesses. Starting the engines and taxiing to the catapult took about five minutes. Red Man hollered over the interphone to get ready as I felt the catapult shuttle engage the nose tow bar and the engines spool up to 100 percent. Then came a big jerk forward, followed a loud *bang*. A cloth curtain separating the cockpit from the TACCO's area angled backward about thirty degrees during the cat stroke. In three and a half seconds, TOPCAT 706 reached the end of the deck and was airborne at 160 knots.

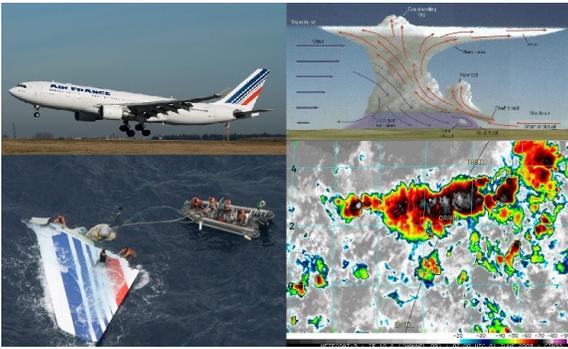
Red Man and I switched seats during the climb to eighteen thousand feet, where we tanked the SUCAP Hornets. I wanted to get into the seat as fast as I could as Stick trailed the buddy store drogue. Two Hornets joined off our right-wing, taking four thousand pounds each. It was a perfect morning for snapping pictures. Done with refueling, Stick rolled the Viking onto its back and pulled straight down toward The Indian Ocean. We leveled off at 1,500 feet, and Red Man called out our first ship contact at two o'clock for eight miles. Stick then gave me control of the aircraft. Banking right, I looked for the ship on the forward-looking infrared (FLIR) projected on the multifunction display in front of me. As we passed aft of a large gray-green cargo ship, Stick passed the ship's name and registry to Red Man. We flew from ship to ship, Red Man logging names, courses, speeds, and national registry. No one on the ships seemed to care as we buzzed them. One fellow on a ship came out of the bridge and waved at us as we passed aft.

We headed back to the *Kennedy* and the recovery stack, our wingman TOPCAT 702 radioing for us to join him, too heavy for an arrested landing. We were going to "swap spit," as Viking crews called it: we would take on some of 702's gas. Our Viking was lighter after giving a lot of gas to the SUCAP Hornets. As we pulled up behind it, I noticed TOPCAT 702's FLIR turret pointing at us. Stick said they always watched receivers behind them on the FLIR. The Viking's refueling probe extended above our heads as we pulled in behind TOPCAT 702. 702's drogue reeled out of the buddy store on their left-wing and dangled in front of us. I was captivated watching probe refueling from the receiver's perspective. The basket hovered in front of us, barely moving. Stick mentioned that it was easier to refuel in the morning because of the calmer air. We plugged in on the first try, and the gas gauge needle climbed as fuel passed from 702.

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Obituary: CDR Robert A. “Bob” Johnson, USN (Ret) (1947-2020)

“CDR Robert A. Johnson was the speaker for the AIAA LA-LV AF-447 Aircraft Safety (2017) and the Carrier Landing (2018) events, both held in the Northrop Grumman S-Cafe.” ([Continued from Page 4](#))



AIAA LA-LV AF-447 Aircraft Safety Presentation by CDR Robert A. Johnson on 10 Aug., 2017 in Northrop Grumman S-Cafe.

During this tour Bob flew 109 combat missions, including a mission to take the first photos of the pontoon bridge in Vinh on the first operational flight of the AAS-21 IR sensor, in heavy weather and under extreme radar-directed AAA fire.

In January 1969 Bob attended the US Navy Test Pilot School, Class 53 and upon graduation was assigned to the Carrier Suitability Branch of the Flight Test Division, NATC Patuxent River, MD. He became Branch Head as a Lieutenant Commander in what was designated a Commander's billet. While there until the summer of 1972, he flew carrier test flights in the A-3B, RA-5C, A6, EA-6B (initial Sea Trials), A-7, F-4 and C-2A. He flew the ACLS Deck Motion Compensation Trials aboard the USS Coral Sea, where he recalled “swells were so long and high that on occasion both the bottom of the bow and the four screws turning could be seen at the same time.” A true bagger, Bob set a record for carrier landings in one day by making 50 traps aboard USS Kitty Hawk in support of a very high priority test program to clear the C-2A for carrier operations after two fatal crashes.

Selected for command, now Commander Bob Johnson returned to RVAH-3 in July 1972 for refresher training in the RA-5C before reporting as XO of RVAH-7 based at NAS Key West, FL. He made his fifth and last deployment flying the RA-5C as CO of RVAH-7 to the Western Pacific and Indian Ocean, embarked once again in USS Kitty Hawk. On that deployment in 1974 he participated in an Air Show for the Shah of Iran.

Bob's final tour was again in Command, when in December 1974 he became the 18th Director, US Naval Test Pilot School at NATC Patuxent River, MD, as the most junior Director ever, performing in a Captain's billet. He was hand-picked to “correct severe safety and morale problems and reorganize the school.” He credits his success in achieving these goals to a team effort with his wife Gail. A stern, but compassionate and extremely fair leader, he motivated his crew with the motto; “Write the Plan, Fly the Plan, or Plan to get Hammered!” Bob



AIAA LA-LV Carrier Landing Suitability Test Presentation by CDR Robert A. Johnson on 27 Feb., 2018 in Northrop Grumman S-Cafe.

retired from active duty in August 1977, completing just over 20 years of service flying the most challenging naval aircraft in the most demanding environment at sea. He was extremely proud of a career in which he was always assigned to duty involving flying, never had an accident, and in his command tours, never lost a pilot or an airplane. He accumulated nearly 4200 flight hours, flying 46 different types of aircraft excelling in both flight test and combat, where he was awarded the Air Medal, 9 Strike Flight Air Medals and 3 Navy Commendation Medals with Combat V.

Bob transitioned to the private sector in 1977 and began a second career in the aerospace industry. He first landed a job with McDonnell Douglas as marketing Director for the F/A-18, primarily negotiating foreign sales to Canada and others. After two years in St Louis, he received an offer from Northrop and moved the family to California where he served as the Customer Requirements Manager for the Northrop B-2 Spirit Bomber program, settling in Palos Verdes Estates, CA. There, after his career in aerospace, he followed his passion for civil engineering from his college years as a Wisconsin Badger, and became active as a General Contractor, building a widely respected reputation and strong bond with the Palos Verdes community

Bob was especially proud of being a Golden Eagle. He and his wife Gail were always a bright light attending the West Flight mini-Reunion Luncheons, traveling from Palos Verdes in L.A. to San Diego to join up with other long-time friends and share stories that continued to improve with age. Bob is survived by his loving wife Gail, three sons Scott, Kristopher, and Niclas, and two granddaughters, Sarah and Hannah.

The family will conduct a private spiritual closure ceremony at their Palos Verdes home this weekend. No decision will be made for a celebration of life and Memorial Service until the current restriction on large gatherings is lifted, with interment to follow, most likely at Miramar National Cemetery.

COVID-19 U.S. Mortality Trends *(Continued from Page 6)*

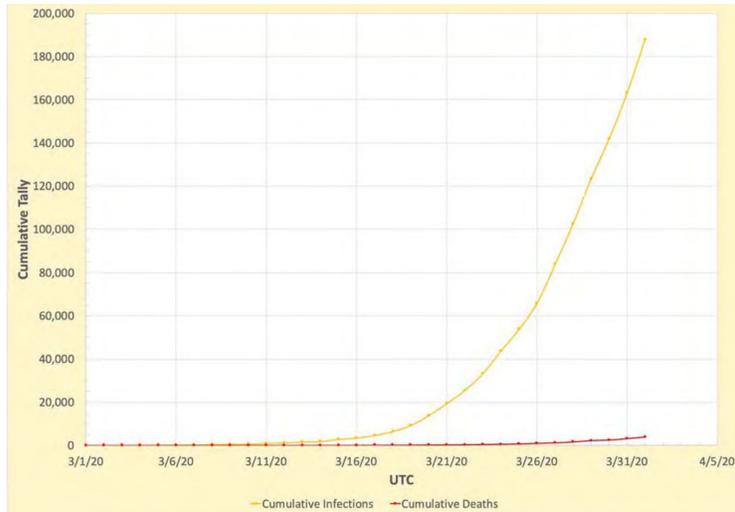


Figure 1. Cumulative infections and cumulative deaths attributable to COVID-19 in the U.S. are plotted on a linear scale as a function of time from 1.0 March to 1.0 April 2020 UTC. A decimal zero UTC date signifies the beginning of that date and corresponds to tick marks on UTC scales of this and subsequent figures.

Plots with linear scales akin to Figure 1's suffer from an inability to track the dynamic range spanned by exponential growth over time. Early in the growth cycle, plots like Figure 1's cumulative deaths curve are nearly horizontal. Midway in the growth cycle, plots like the cumulative infections curve in Figure 1 do show meaningful variations. But sooner or later, exponential growth becomes rapid enough in the growth cycle to drive a plotted curve nearly vertical at any meaningful linear scale. In late March, Figure 1's cumulative infections plot is rapidly approaching this nearly infinite growth rate. It remains to be seen if social distancing policy will stem this mature growth cycle before deaths do.

Multiple shortcomings in Figure 1 are addressed in Figure 2 by changing the linear vertical scale to *logarithmic*. On Figure 2's vertical axis, successive major divisions span a power of 10 in COVID-19 U.S. casualties as opposed to a fixed number of them. Therefore, the degree to which Figure 2 curves depart from a straight line is the degree to which they depart from exponential growth. Both the cumulative infections and cumulative deaths curves in Figure 2 are highly linear, and departures from that condition are easily perceived.

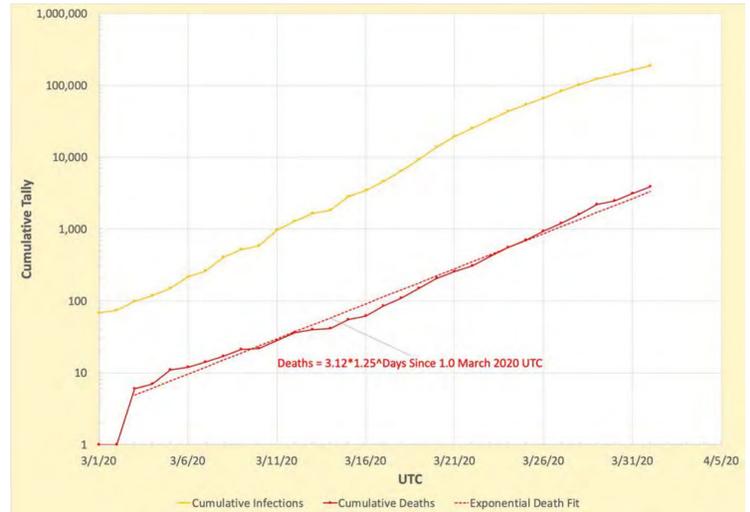


Figure 2. Cumulative infections and cumulative deaths attributable to COVID-19 in the U.S. are plotted on a logarithmic scale as a function of time from 1.0 March to 1.0 April 2020 UTC. An exponential fit to cumulative deaths values is also plotted as a dashed line over the fit interval from 3.0 March to 1.0 April UTC. The fit may be used to predict cumulative deaths, assuming continued exponential growth of this tally.

The degree of linearity in Figure 2's cumulative deaths curve invites an exponential fit of the form $D(\Delta t) = f b^{\Delta t}$, where $D(\Delta t)$ is the estimated cumulative U.S. deaths attributable to COVID-19, and the exponent Δt is the number of days since 1.0 March 2020 UTC. The parameters f and b are computed using values D_i for cumulative U.S. COVID-19 deaths obtained from corona.help at two or more UTCs. Values for f and b minimize the sum of ΔD_i , where ΔD_i is the deviation of $D(\Delta t)$ from each D_i used in the exponential fit. The dashed line in Figure 2 plots $D(\Delta t)$ over the UTC fit interval.

Exponential Growth Predictions and Trends

Now consider a trending metric $T_3\%$ arising from exponential fits such as annotated in Figure 2. Imagine extending the Figure 2 fit function $D(\Delta t)$ into the future until a large value, bordering on cataclysmic and equivalent to 3% of the U.S. population, is reached. The UTC at which this occurs is the $T_3\%$ metric. From this paper's introductory caveats, recall cumulative deaths reported by corona.help and other sources are inherently less than actual at any time. This everpresent bias tends to delay $T_3\%$ versus reality, but its effect on $T_3\%$ trends is viewed to be relatively insignificant. Figure 3 plots daily $T_3\%$ variations as additional D_i values are progressively brought into the $D(\Delta t)$ exponential fit.

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COVID-19 U.S. Mortality Trends *(Continued from the Previous Page)*

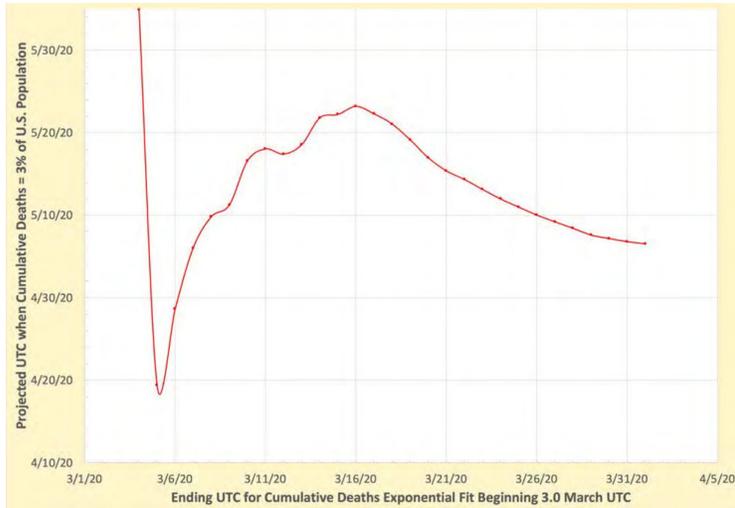


Figure 3. Variations in the UTC $T_3\%$ (at which COVID-19 deaths in the U.S. are projected to be 3% of the pre-infection 2020 U.S. population) are plotted as a function of the last UTC used to fit the exponential function $D(\Delta t)$ from which $T_3\%$ is inferred. Each fit begins on 3.0 March 2020 UTC.

Cumulative deaths corresponding to 3% of the U.S. population in 2020 are 9.89 million in number. This 3% tally is chosen to compute $T_3\%$ because it is at or above any contemplated U.S. COVID-19 mortality rate, even with impaired medical intervention, and therefore tends to be a worst case bounding more optimistic plausible outcomes. Mortality rate is typically defined with respect to those afflicted who perish; not with respect to an entire population. In that context, COVID-19 U.S. deaths totaling 9.89 million are also a worst case.

Initial $T_3\%$ variations in Figure 3 are relatively large because associated cumulative death counts D_i used to compute $D(\Delta t)$ are few in number and small in value. For example, the leftmost $T_3\%$ in Figure 3 is associated with a $D(\Delta t)$ using only two values ($D_1 = 6$ on 3.0 March UTC and $D_2 = 7$ on 4.0 March UTC) for its exponential fit. As additional D_i are added to this fit, $T_3\%$'s pedigree gains "statistic weight" and begins to converge on dates in early May.

The trend toward earlier $T_3\%$ among Figure 3's more converged values is cause for concern. As of late March, this trend indicates social distancing and other factors influencing cumulative COVID-19 deaths in the U.S. have yet to produce a reduction in exponential growth. If anything, that growth is accelerating, and further monitoring of this disturbing trend is warranted.

9 April 2020 Addendum

Figure 2 is updated to incorporate data as recent as 9.0 April UTC in Figure 4. Note the departure from exponential growth in cumulative COVID-19 infections, as indicated by decreasing slope in its logarithmic plot since circa 20 March. Any such exponential departure in Figure 4's cumulative deaths plot is far more subtle and ephemeral. This inconsistency may be attributable to the previously noted nature of deaths as a lagging statistic with respect to infections. Because Figure 4's logarithmic cumulative deaths plot is still reasonably linear, the corresponding $D(\Delta t)$ fit is as valid as ever when extrapolated into the future.

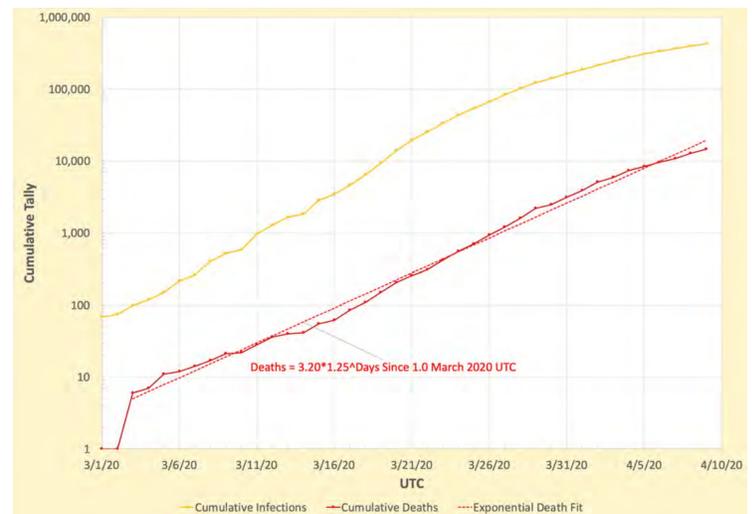


Figure 4. Cumulative infections and cumulative deaths attributable to COVID-19 in the U.S. are plotted on a logarithmic scale as a function of time from 1.0 March to 9.0 April 2020 UTC. An exponential fit to cumulative deaths values is also plotted as a dashed line over the fit interval from 3.0 March to 9.0 April UTC. The fit may be used to predict cumulative deaths, assuming continued exponential growth of this tally.

Figure 3 is updated in Figure 5 to incorporate $T_3\%$ predictions based on exponential fits to cumulative deaths data as recent as 9.0 April UTC. The earliest recently predicted $T_3\%$ in Figure 5 is 6.007 May UTC, as extrapolated from the $D(\Delta t)$ fit to cumulative U.S. deaths from 1.0 March to 4.0 April UTC. Thus, a local minimum in $T_3\%$ is evident near 4 April on Figure 5's horizontal axis.

(Continued on the Next Page)

COVID-19 U.S. Mortality Trends *(Continued from the Previous Page)*

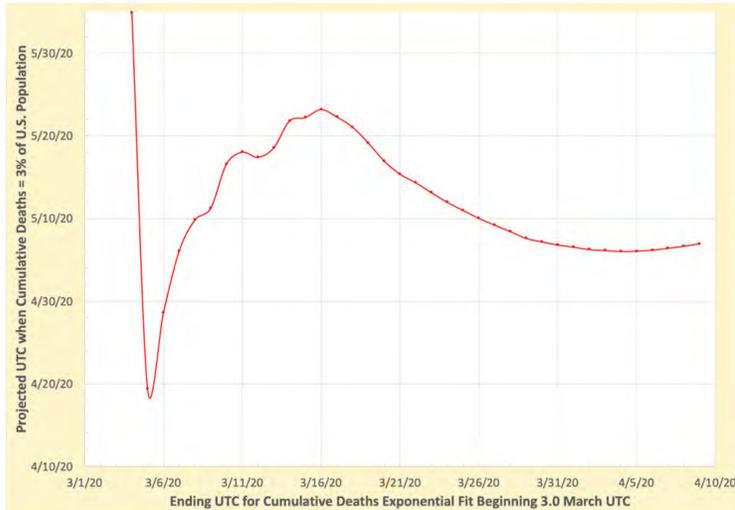


Figure 5. Variations in the UTC $T_3\%$ (at which COVID-19 deaths in the U.S. are projected to be 3% of the pre-infection 2020 U.S. population) are plotted as a function of the last UTC used to fit the exponential function $D(\Delta t)$ from which $T_3\%$ is inferred. Each fit begins on 3.0 March 2020 UTC.

A new trending metric $\Delta T_3\%$, equivalent to localized slope in the Figure 5 plot, has been developed. Consider the latest values plotted in Figure 5. These have $T_3\% = 6.630$ May UTC from the $D(\Delta t)$ fit ending 8.0 April UTC and $T_3\% = 6.924$ May UTC from the $D(\Delta t)$ fit ending 9.0 April UTC. The difference in these two $T_3\%$ values, divided by the single day between their respective $D(\Delta t)$ fit-ending UTCs, produces the dimensionless result $\Delta T_3\% = (6.924 - 6.630)/1 = +0.294$.

The latest positive trend in $\Delta T_3\%$ indicates social distancing and other COVID-19 mitigation policies are beginning to bear fruit nationwide. But positive $\Delta T_3\%$ values not well in excess of +1.0 are insufficient for a return to anything reminiscent of casual social distancing. If $\Delta T_3\%$ is barely positive, advancing UTC is closing in on $T_3\%$ faster than $T_3\%$ is advancing. To eradicate the pandemic's mortality threat, $\Delta T_3\%$ must be clearly and consistently greater than +1.0. For reference, New York State's $\Delta T_3\%$ inferred from $D(\Delta t)$ fits ending on 8.0 April and 9.0 April is +0.748 and California's is +0.982.

23 April 2020 Addendum

Since 9 April's addendum, trends toward sub-exponential growth in U.S. cumulative COVID-19 deaths and infections have continued, indicating social distancing practices are controlling the pandemic's spread to some

degree. This is evident in Figure 6 (an update to Figure 4) because the solid red cumulative deaths plot is no longer linear on its vertical logarithmic scale. This curve has "flattened", and the dashed red exponential fit to these data is overpredicting them in the last half of April. For example, cumulative deaths at 23.0 April UTC are 47,548, but the exponential fit at that time is 143,783 (a fit value 3.02 times greater than the corresponding datum). Extrapolating the exponential fit into May and beyond is therefore inadvisable due to the likelihood even more grossly overpredicted cumulative deaths will result. However, future exponential fits may be warranted if social isolation policies are relaxed prematurely

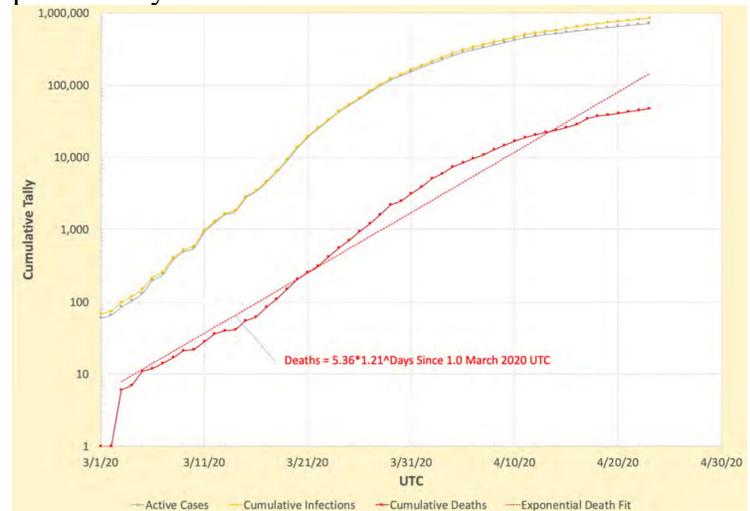


Figure 6. Active cases, cumulative infections, and cumulative deaths attributable to COVID-19 in the U.S. are plotted on a logarithmic scale as a function of time from 1.0 March to 23.0 April 2020 UTC. An exponential fit to cumulative deaths values is also plotted as a dashed line over the fit interval from 3.0 March to 23.0 April UTC. The latest cumulative deaths data indicate the fit will overpredict these data into the near future.

A new dataset, U.S. active COVID-19 cases, is introduced in Figure 6 (the solid gray plot) for the first time in this paper. Unlike cumulative infections and cumulative deaths, active cases can decrease with time. At any time, active cases are equivalent to cumulative cases minus cumulative deaths minus cumulative recoveries. The degree to which finite U.S. Medical resources are being overburdened is conveyed by active cases data.

(Continued on the Next Page)

COVID-19 U.S. Mortality Trends (Continued from the Previous Page)

With pressure to relax social distancing policies on the rise recently, the concept of *herd immunity* becomes increasingly relevant.³ If the U.S. population has a sufficient segment of individuals with immunity to COVID-19 infection, herd immunity will prevent significant future outbreaks of the pandemic and active cases will tend to decrease. It has yet to be conclusively proven that recovery from COVID-19 infection confers immunity to reinfection over significant periods of a year or more, but the medical community is proceeding under this assumption for now. Nor is it completely certain how infectious COVID-19 is. Current estimates are each infection begets between 2 and 2.5 new infections. Under these assumptions, epidemiologists estimate cumulative infections must reach at least 60% for a population to achieve COVID-19 herd immunity. Figure 7, an update of Figure 1, attempts to develop one means of predicting when U.S. cumulative infections will reach 60%, about 200 million individuals.

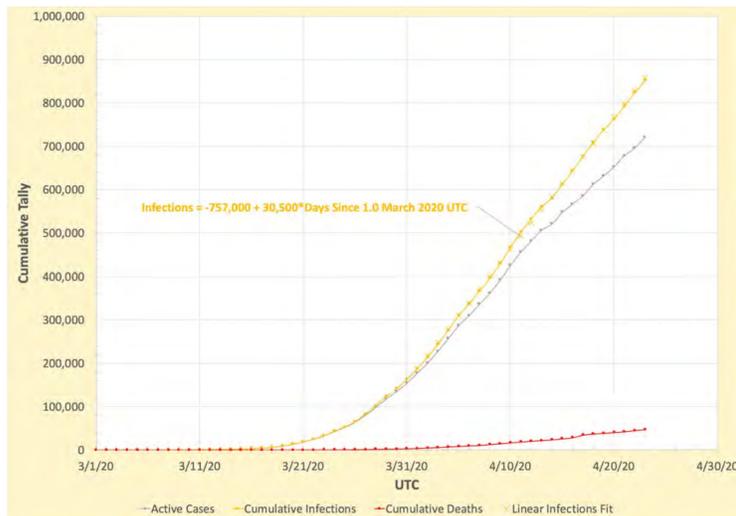


Figure 7. Active cases, cumulative infections, and cumulative deaths attributable to COVID-19 in the U.S. are plotted on a linear scale as a function of time from 1.0 March to 23.0 April 2020 UTC. Yellow "X" markers denote a linear best fit to cumulative infections data beginning on 1.0 April.

The key new predictive feature in Figure 7 is a linear best fit to cumulative infections data from 1.0 April to 23.0 April UTC. On the latter date, the cumulative infections datum is 851,977 and the linear fit value is 857,480. The linear fit is only 1.006 times greater than the corresponding datum, far more accurate than the exponential fit to cumulative deaths associated with Figure 6 for the same UTC. This level of accuracy invites extrapolation of the linear fit to determine $T_{60\%}$, the UTC at which cumulative infections are 60% of the U.S. population. Using a linear fit from 1.0 April to 23.0 April 2020, $T_{60\%}$ is predicted to fall on 4 January 2038 UTC.

The protracted interval (6487 days or 17.76 years) between 1.0 April 2020 UTC and $T_{60\%}$ is not surprising given the fit's infection rate as annotated in Figure 7: 30,500 new infections

per day.

As an approximate sanity check on time to $T_{60\%}$, the quotient of 200 million divided by the fit's infection rate is in the ballpark at 6557 days.

A more meaningful sanity check on $T_{60\%}$ is connected with an assertion running throughout this paper. Cumulative infections and cumulative deaths are undoubtedly under-counts with respect to the real world for reasons cited in the Introduction section. Only *trends* in these data are relevant to understanding the true COVID-19 pandemic's situation. Thus, the cumulative infections datum on 23.0 April 2020 UTC amounts to 0.26% of the U.S. population and is not trustworthy. The only take-away meaningful to U.S. COVID-19 situation awareness is that infections are increasing at a nearly constant rate as of late April 2020. Infection rates in the U.S. are the subject of continuing investigations. Estimates of actual cumulative infections in early April are ranging from 50 to 85 times greater than corresponding data presented in this paper.⁴

Suppose the U.S. infection rate in April 2020 is really $30,500 \times 50 = 1,525,000$ new infections per day. If that rate is sustained, $T_{60\%}$ would be reached about 130 days after 1.0 April UTC at 9.0 August 2020 UTC.

Of course, herd immunity can be achieved and maintained with widespread use of an effective vaccine. Official estimates of a U.S. vaccine becoming available for COVID-19 range from 12 to 18 months and appear optimistic. The minimum time previously required to develop a safe and effective vaccine is 4 years. This record was set for a mumps and measles vaccine developed in the 1960s, when governing regulations were relatively lax by current standards.⁵

In summary, if U.S. COVID-19 cumulative infections are being undercounted by anything like a factor of 50, herd immunity could be achieved naturally well in advance of a vaccine becoming widely available in late 2021 or thereafter. But will the U.S. achieve herd immunity naturally with premature growth in active COVID-19 cases such that limited medical resources become overwhelmed and we incur far more cumulative deaths than under more controlled conditions?

How current social distancing policy evolves will govern the natural herd immunity outcome to a great degree.

³Articles reporting expert opinions on herd immunity can be found at <https://www.jhsph.edu/covid-19/articles/achieving-herd-immunity-with-covid19.html> and at <https://www.businessinsider.com/us-covid-19-herdimmunity-2020-4> (both articles accessed on 22 April 2020).

⁴Reference the report at <https://www.rt.com/usa/486183-stanford-coronavirus-infection-rate-higher/> (accessed 23 April 2020).

⁵Reference the report at <https://www.msn.com/en-us/health/other/a-coronavirus-vaccine-in-18-months-experts-areskeptical/ar-BB11Yzjh> (accessed 23 April 2020). (Continued on the Next Page)

COVID-19 U.S. Mortality Trends *(Continued from the Previous Page)*

18 May 2020 Addendum

A milestone in U.S. COVID-19 statistics was achieved at 13.0 May UTC. As illustrated by Figure 8's gray curve, active COVID-19 infections *decreased* during the previous 24 hours on that date for the first time during the pandemic.

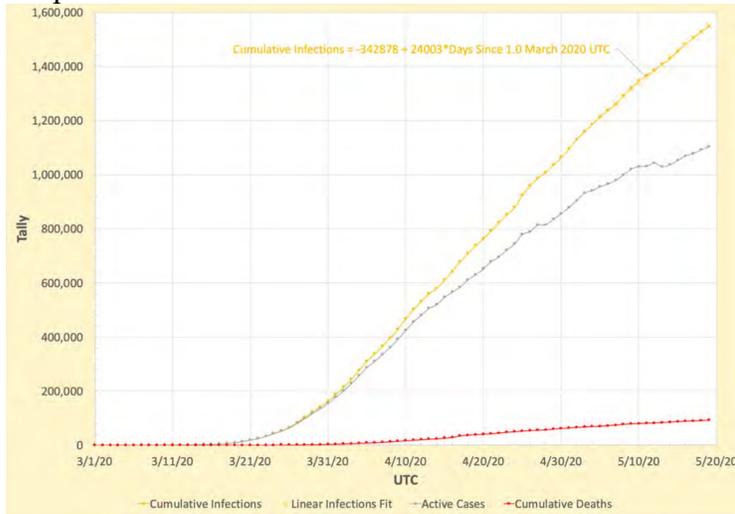


Figure 8. Active cases, cumulative infections, and cumulative deaths attributable to COVID-19 in the U.S. are plotted on a linear scale as a function of time from 1.0 March to 19.0 May 2020 UTC. Yellow "X" markers denote a linear best fit to cumulative infections data beginning on 5.0 May and ending 14 days later on 19.0 May UTC.

This encouraging milestone is all too fleeting, however. A one-day decrease in active cases may be more attributable to testing "noise" and weekly health care personnel duty cycles than to any meaningful trend. Longer term, as regions in the U.S. begin to relax social distancing policies and "open up" their economies in mid-May, consequences may be foretold by South Korea. After taking similar measures in late April,⁶ this country has seen resumed increases in its cumulative infections during May.⁷ Unfortunately, it will require at least two weeks for relaxed U.S. policies to be reflected in hard statistics. By then, exponential growth in U.S. Cumulative infections may have resumed, to be followed weeks later by proportional increases in U.S. cumulative deaths.

Figure 8 also inaugurates a new analysis technique for this paper: the sliding 14-day linear fit.

Because many COVID-19 cases appear to progress over a 14-day period, disease control policies often require a trend persist for two weeks before an associated action

may be taken. For example, consider the Center for Disease Control and Prevention (CDC) criterion that social distancing guidelines may be relaxed to some initial degree after the daily number of new COVID-19 cases decreases for 14 consecutive days.⁸ Such a trend is equivalent to a more negative slope (or flattening) in Figure 8's yellow cumulative infections curve over two weeks.

The 14-day linear fit from 5.0 May to 19.0 May UTC in Figure 8 smooths out irregularities such as the 12.0-13.0 May UTC decrease in active cases noted previously. This fit is associated with a slope called D_{14} , equivalent to the average daily change in new infections over the previous 14 days. Although D_{14} can never be negative, values approaching zero signal at least a short-term hiatus in the pandemic has been achieved. Daily variations in D_{14} are plotted in Figure 9.

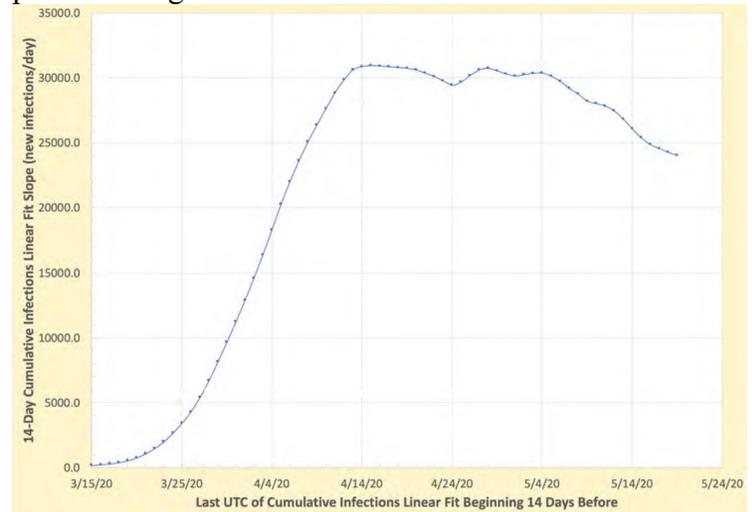


Figure 9. Slopes for progressively later or "sliding" 14-day linear fits to cumulative U.S. COVID-19 infections are plotted as a function of each fit's ending UTC. For example, the last point on 19.0 May UTC is the slope of the fit plotted in Figure 8 (reference "X" markers) beginning 5.0 May and ending 14 days later. Per the Figure 8 fit annotation, the last point's slope in Figure 9 is 24,003 new infections tallied nationwide each day.

⁶ Reference <https://www.cbsnews.com/news/coronavirus-south-korea-cluster-reopened-nightclubs-delaysreopening-schools-today-2020-05-11/> (accessed 14 May 2020).

⁷Reference the "Infection history" plot at <https://corona.help/country/south-korea> (accessed 13 May 2020).

⁸Reference <https://www.whitehouse.gov/wp-content/uploads/2020/04/Guidelines-for-Opening-Up-America-Again.pdf> (accessed 18 May 2020). Note this criterion was never officially adopted or enforced nationally.

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COVID-19 U.S. Mortality Trends *(Continued from the Previous Page)*

Figure 9 chronicles an uninterrupted sequence of 15 decreasing D_{14} values beginning with 30,358 new infections per day on 4.0 May UTC and ending with 24,003 new infections per day on 19.0 May, an overall reduction of 20%. This sequence is marginally compliant with the CDC's recommended condition for initial easing of social distancing restrictions. Unfortunately, the reduction rate in D_{14} may be bottoming out in mid-May, as is evident in Figure 9. It may begin to increase again in late May or early June, particularly if too many localized regions not meeting the CDC criterion relax their social distancing policies prematurely.

In a manner akin to Figure 7's 22-day linear fit, Figure 8's 14-day linear fit can be extrapolated to a UTC at which 60% of the U.S. population has been infected and the earliest hope for herd immunity to COVID-19 in this country can be expected. At the rate of 24,003 new infections per day, the resulting $T_{60\%}$ falls on 7 October 2042 UTC. A $T_{60\%}$ more than 22 years in the future appears to be an absurd result for a highly contagious virus in the midst of a worldwide pandemic. Even the Bubonic plague's outbreak in medieval Europe lasted a relatively scant 7 years, from 1346 to 1353, despite crude modes of transportation by modern standards.⁹ It is therefore most likely $T_{60\%}$ is indicating infections continue to be grossly underreported nationwide. Until a comprehensive testing program is conducted throughout the U.S. to infer asymptomatic and other unreported COVID-19 cases in the cumulative infections tally, tardy $T_{60\%}$ estimates can be expected to persist.

27 June 2020 Addendum

In May and June of 2020, states experiencing high infection rates early in the pandemic reduced those rates significantly. For example, cumulative infections in New York State numbered 75,833 on 1.0 April UTC, 304,372 on 1.0 May UTC, 370,770 on 1.0 June UTC, and 391,220 on 27.0 June UTC.¹⁰ This helped "flatten" the U.S. cumulative infections curve during those two months. Unfortunately, other states were in the process of relaxing their social distancing policies during this time, leading to dramatic increases in cumulative infections. For example, Texas cumulative infections numbered 3757 on 1.0 April UTC, 28,313 on 1.0 May UTC, 64,423 on 1.0 June UTC, and 140,167 on 27.0 June UTC.¹¹ As a consequence, slopes of progressively later 14-day linear fits to the U.S. cumulative infections curve, as measured in infections per day, underwent a gradual decrease in

May only to be followed by a sharp increase after 20.0 June. These trends are illustrated in Figure 10, an update of Figure 9, where the recent increase resembles that in late March.

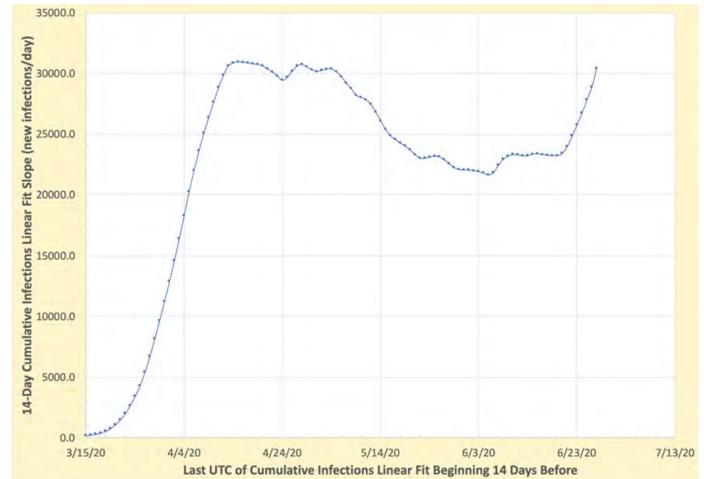


Figure 10. Slopes for progressively later or "sliding" 14-day linear fits to cumulative U.S. COVID-19 infections are plotted as a function of each fit's ending UTC. For example, the last point on 27.0 June UTC is the slope of the fit ending on that date and beginning on 13.0 June UTC. This slope has a value of 30,416.6 new infections per day.

On 25 June 2020, NBC News quoted Dr. Robert Redfield, CDC Director, as stating "Our best estimate right now is that for every case that's reported, there actually are 10 other infections."¹²

Assuming that estimate, cumulative U.S. infections reported from 13.0 June 2020 UTC to 27.0 June 2020 UTC (corresponding to the last point plotted in Figure 10) are all increased by a factor of 10 and a linear best fit is obtained to the 14 inflated data points. Not surprisingly, this fit inflates the last slope potted in Figure 10 by a factor of 10 to 304,166.2 new cases per day. At that rate, $T_{60\%}$, the time at which cumulative U.S. infections reach 60% of the population, moves earlier to a more "reasonable" 15 January 2022. Thus, if a safe and effective vaccine does not materialize in early 2021 as some optimists predict, the U.S. may well achieve herd immunity one year later, and the COVID-19 pandemic will then simply fade away spontaneously.

⁹ Reference <https://www.history.com/news/black-death-timeline> (accessed 18 May 2020).

¹⁰ Reference <https://corona.help/country/usa/new-york> (accessed 26 June 2020).

¹¹ Reference <https://corona.help/country/usa/texas> (accessed 26 June 2020).

¹² Reference <https://www.nbcnews.com/health/health-news/cdc-says-covid-19-cases-u-s-may-be-10-n1232134> (accessed 27 June 2020).

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COVID-19 U.S. Mortality Trends *(Continued from the Previous Page)*

25 September Addendum

Since the previous midsummer 2020 addendum to this paper, trends in the U.S. COVID-19 infection rate have undergone an alarming surge, subsequently abating to a level exceeding any seen in Figure 10. Figure 11 illustrates these variations and is accompanied by annotations dating national holidays which may have challenged social distancing practices. This summer's trends in U.S. infections do not bode well for the next half-year, when inclement weather will impose increased indoor time on nearly all lifestyles.¹³

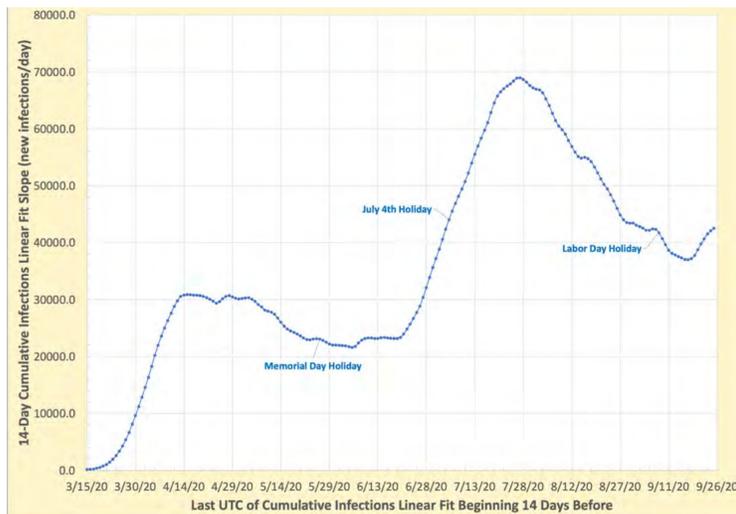


Figure 11. Slopes for progressively later or "sliding" 14-day linear fits to cumulative U.S. COVID-19 infections are plotted as a function of each fit's ending UTC. For example, the last point on 25.0 September UTC is the slope of the fit ending on that date and beginning on 11.0 September UTC. This slope has a value of 42,501.6 new infections per day.

With the current U.S. infection rate near 42,500 per day, the herd immunity date $T_{60\%}$ is 5 January 2033. Assuming the actual infection rate is near 425,000 per day, $T_{60\%}$ shifts to 18 July 2021. However, the current state of COVID-19 knowledge warrants repeating a disclaimer.

There is no conclusive proof that humans can develop long-term resistance to COVID-19 infection and thereby produce herd immunity naturally.¹⁴

¹³ Reference <https://www.yahoo.com/lifestyle/bad-second-wave-coronavirus-could-203600568.html> (accessed 25 September 2020)

¹⁴ Reference <https://news.yahoo.com/why-a-herd-immunity-approach-to-covid-19-could-be-a-deadly-disaster-153057073.html> (accessed 25 September 2020).

NASA Receives First Lunar CubeRover from Astrobotic *(Continued from Page 8)*

Astrobotic fulfills NASA's \$750k SBIR contract for developing a lightweight planetary rover

outfits the rover with a set of advanced features including a lighter all-wheel-drive system, a solar array for recharging, adaptive image compression, and additional interfaces to support a wider variety of landers and payloads.

About Astrobotic

Astrobotic Technology, Inc. is a space robotics company making space accessible to the world. They develop advanced navigation, operation, and computing systems for spacecraft, and their fleet of lunar landers and rovers deliver payloads to the Moon for companies, governments, universities, non-profits, and individuals. The company has more than 50 prior and ongoing NASA and commercial technology contracts and a corporate sponsorship with DHL. Astrobotic was founded in 2007 and is headquartered in Pittsburgh, PA.



Astrobotic's 2U CubeRover navigates ground testing before being sent to Kennedy Space Center.



Questioning Mars as humanity's ultimate 21st century pioneering destination in space (based on the AIAA LA-LV e-Town Hall Meeting 8 August, 2020) *(Continued from Page 11)*

Describing images returned from the Martian surface by the robotic rover *Curiosity* in 2012, Adamo exclaimed, "It looks like home!"

Indeed, many of these pictures show a desert landscape that closely resembles parts of the American Southwest, North Africa, Antarctica, the Middle East or Southwest Asia. Adamo says this likeness is misleading.

"The thin Martian atmosphere provides no shielding against cosmic radiation," he explained. "Exposure inside above-surface habitats, space suits, and unpressurized rovers would provide inadequate radiation shielding to support 500-day duty tours, let alone multi-generation pioneering."

Additionally, the rusty soil, composed mainly of magnetic iron oxides, clings to any surface with a slight electrostatic charge, including solar panels and motors. This is more than just a hazard to machinery and electronics. The Martian sky typically has a rosy hue due to suspended dust particles, which also contain carcinogenic compounds such as hexavalent chromium and toxic perchlorates that affect the human thyroid gland.



The Red Planet. (NASA photograph)

Adamo said extraordinary measures would be required to exclude dust and soil from the interior surfaces and atmosphere of habitat modules. Future explorers would do well to remember the experience of Apollo astronauts, who described smelling and tasting moon dust after removing their helmets inside the lunar lander after each surface excursion.

Those are only the problems awaiting humans on the surface, Adamo said. The journey to and from the Red Planet poses an equally large set of obstacles. The orbits of Earth and Mars align optimally only once every 26 months. Even under ideal circumstances, transit time between the two planets would take months, and any meaningful mission would last at least a couple years if not longer. Mission planners need to address the need for shielding against cosmic radiation, as well as for providing sufficient supplies of consumables — energy, oxygen, food and water — for the duration. New

technologies are required to develop a Mars lander capable of surviving the plunge into the Martian atmosphere and gravity well and making a successful soft landing. "The one-ton *Curiosity* rover represents the current state of the art for the mass that we can land on Mars," said Adamo. A lander carrying a crew and supplies would be much heavier.

Reduced gravity entails another set of challenges. Millions of years of evolution have optimized humans to live under Earth's gravitational conditions, and astronauts living in microgravity during long-term space flights have returned with noticeable loss of bone and muscle mass. During transit to Mars this could be offset through the use of rotating habitat modules to simulate Earth-normal gravity. There is no practical way to do this on the Martian surface, where gravity is only 38 percent that of Earth. Additionally, getting back home following a Mars mission will involve substantial acceleration and deceleration that will expose crewmembers to high g-loads following their extended low-g sojourn.

(Speaker's note: It's possible a rotating habitat, canted at the proper angle such that centrifugal acceleration and Mars gravity acceleration are sensed to be down through the habitat floor, could be put into operation)

Explorers and pioneers

According to Adamo, human activity in space can be divided into two categories, exploring and pioneering. Exploring entails a survey of foreign territory such as Lewis and Clark's Corps of Discovery expedition across western North America in the early 1800s. Pioneering involves putting down roots for a multi-generational occupation of foreign territory, as with the Pilgrims in 1620.

"Exploration is a big part of NASA's charter," Adamo said. "Pioneering is not."

He suggested the most logical approach would be to explore the Martian surface with robots under human control from a remote location such as a subsurface base on Deimos, the smaller and more distant of two moons orbiting Mars. Like Earth's moon, Deimos is tidally locked with its parent planet, always presenting the same face toward the Martian surface. At an orbital distance of slightly under 15,000 miles it is close enough to facilitate

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Questioning Mars as humanity's ultimate 21st century pioneering destination in space (based on the AIAA LA-LV e-Town Hall Meeting 8 August, 2020)

(Continued from the Previous Page)

near-instantaneous remote operation of robotic rovers, yet far enough away to allow observation of 98 percent of the planet's surface and allow line-of-sight communications for 60 continuous hours at a time. The gravitational pull of Deimos is slight, making landing easier than on Mars, and the moon is large enough for construction of a subsurface rotating habitat to provide artificial gravity for inhabitants. Power-generating solar panels positioned at the poles would receive almost perpetual sunlight.

Mars, says Adamo, has become widely accepted as the ultimate 21st century pioneering destination in space. "Unlike exploring," he explained, "pioneering must be conducted by humans in situ, and ultimately return sustained profits.

"Historically, human pioneering is usually undertaken for compelling reasons," he continued, such as to escape from war, starvation, persecution and pestilence. It may also represent territorial expansion motivated by overcrowding, limited opportunities, poverty, or a desire to exploit resources. That has been the model on Earth but the reasons for pioneering in space are relatively abstract. Adamo noted that there is no predictable threat to widespread survival on Earth for the foreseeable future, nor any exploitable resource compelling enough to start a "Gold Rush" in space. Even if such resources were identified, he argued, they would be more safely and economically exploitable using robotic tools. Besides posing unnecessary risk to human life, the energy and consumables requirements for sustaining a mining colony, for example, would be prohibitive.

The "undiscovered country"

Again, Adamo offered an alternative. "Current knowledge of the 'undiscovered country' within our solar system suggests that numerous small bodies such as near-Earth asteroids represent humanity's best hope for pioneering off Earth in this century," he said. As of October 2014, there were more than 11,500 known NEAs in the inner solar system. "Over 3,100 of these are more accessible than Mars," he added, noting that they can be reached sooner and more easily than can the Red Planet and are guaranteed to furnish ample opportunities to learn more about the nature and origins of our solar system and our home planet.

Those who disagree with Adamo include a growing number of thinkers and technologists who advocate development of a space-faring and multi-planetary civilization, given the increasingly precarious nature of our existence on Earth.

"I think there is a strong humanitarian argument for making life multi-planetary, in order to safeguard the existence of humanity in the event that something catastrophic were to happen," Elon Musk, founder and CEO of [transport services company SpaceX](#), said in a 2014 interview with online publication Aeon.

Musk hopes to see thousands or even tens of thousands of people living in a city-like colony on Mars as early as 2040. His stated goal is to increase the colony's size until it exceeds one million people, a sufficient number — he hopes — to "recreate the entire industrial base" for a sustainable civilization. This is imperative, he believes, to ensure the long-term continuation of our species, which is currently at the mercy of a fragile global ecosystem with limited resources that can easily fall prey to an asteroid collision or some other unforeseen cataclysmic event.

Frank Stratford, founder of the MarsDrive Consortium, an international nonprofit organization that champions private-sector Martian colonization, agrees. "We want to go there to see if we can find evidence of life, a second Genesis, and if we don't find it, we want to establish new life on Mars — our own," he wrote for *The Space Review* in 2009. "For the first time in history a species on Earth has the knowledge and technology to ensure its own survival by seeding life on new worlds," he added. "If there is a planetary crisis, such as the asteroid impact 65 million years ago that wiped out the dinosaurs, and we do nothing, then we will have lost it all."

Adamo doesn't believe we are ready to take this step. "We should continue to explore the surface of Mars robotically from Earth or from Mars orbit; if current or fossilized life exists there, it will be easier to detect and less likely to perish if humans are not present."

He recommends making greater efforts to study human adaptation to reduced gravity in low Earth orbit with rotating habitats and developing routine interplanetary transport for humans and cargo. "We should continue to search for and explore NEAs and comets; more successful pioneering can be done at less risk and expense on small bodies than on the surface of Mars." More important, the technology that will allow humans to live and thrive on the Red Planet is not yet available. "There's nothing out there that's viable, yet," he said, noting that the road to Mars "is still a long, hard row to hoe."

AIAA LA-LV Space Architecture Gathering 22 Aug. 2020 (Student Article)

(Continued from Page 12)

Key Notes from Dr. Marc M. Cohen's

Presentation:

Lunar Studies

<http://space.coop>

2020 ICES Lunar Daytime Paper:

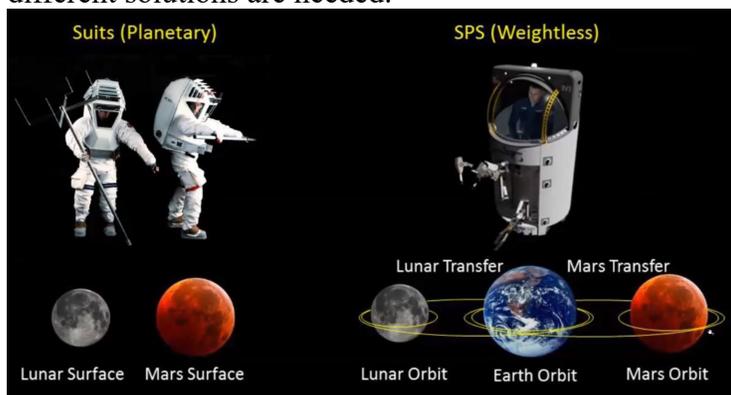
<https://ttu.ir.tdl.org/bitstream/handle/2345/86410/ICES-2020-11.pdf>

Why 14 days? Lunar Day is 14 Earth days. Integrated habitats is being worked on, place in lunar day-time studies and there is a main module in the middle with other modules and one entrance which will connect to Rover to enter integrated habitats. An analog is erected for integrated habitat Project. In space architecture, design is a weak and the main problem, because it is hard to predict the future since we cannot guess how much infrastructure will be needed in the space structures.

Key Notes from Mr. Brand Griffin's Presentation:

Lunar Concepts

As crew module is placed on top, and it made problem of cargo and problem for astronauts to get in and get out. There is a good reason of having space suits than the space-crafts. Space suit should be designed differently for to Moon and Mars land as the two have different environments and two different missions, therefore two different solutions are needed.



Key Notes from Mr. Kriss J. Kennedy's Presentation:

Space Architecture at the Tipping Point

There are different types of Human Exploration Operatios:

- Crew Operations (IVA)
- Crew Operations (Supporting EVA)
- Mission Operations
- Science Operations
- Logistics and Maintenance Operations (IVA and EVA)

www.TECHNE-architect.com

Key Notes from Dr. A. Scott Howe's Presentation:

Space Architecture & Construction

Worked with Japan and also simulated a robotic assembly of outpost. All spidery legs can carry modules and move them to another place and position them next to each other to integrate them to each other. These arms can work for 3D printing, tilting up beams, prefabricating modules.



Key Notes from Mr. John Mankins's Presentation:

(MVA)Moon Village Association Architects are looking for the settlements of Moon in 2024 will be. One part surface of moon is not looked for but many zones had been investing for settling.

Key Notes from Dr. Barbara Imhof's Presentation:

SHEE & EDEN

Moon and Mars Base Elements:

- Stationary Elements
- Mobile Elements
- EVA Systems

EDEN ISS Greenhouse for Moon and Mars is created in Antarctica for growing a lot of vegetables and is deployed there. SHEE Habitat is a self-deployable habitat for extreme environments. It is a testbed for two persons for two weeks at the Antarctica site. Interior has been designed for a better clean surface and small but fully usable interior. Finally, SHEE and Moon Walker Project have been integrated and tested as Martian Analog for Mars Missions.

www.liquifer.com

(Continued on the Next Page)

AIAA LA-LV Space Architecture Gathering 22 Aug. 2020 (Student Article)

(Continued from the Previous Page)

Key Notes from Ms. Barbara Belvisi's Presentation: Simulators

We have problems, while the Earth itself going to worse situation we investigate outer lands and simulate them to apply to Earth and also we have a limited time approx. 10-15 years to analog test some projects before reaching Mars.

Priority is to install a base on the Moon. On the Moon or beyond, everything should be self-recycling system, such as food recycling, water recycling, waste and so and so forth.

EBIOS(Experimental BIOregenerative Station) is modular, scientific model and closer loop village project and it is completely environmentally controlled and sealed and designed as a closed loop ecological system.

Each EBIOS station is engineered and designed as a combination of module:

- to reach high closure for air, water and food loops
- to fulfill the physiological and psychological human requirements in an enclosed environment
- to preserve biodiversity and biological ecosystem

In this project FWW(Food-Water-Waste) System has Aeroponics Dome, Greenhouse Dome and Water&Waste Dome.

Key Notes from Mr. John Spencer's Presentation: Space Tourism, Exploring the Space Experience Design Frontier

Founder of STS (Space Tourism Society)

Outer Space Architecture is a more proper term to use instead of saying only Space Architecture and 2020-2029 will be Space Decade.

His Space Yacht project's concept analogous to the sea yacht design from Naval Architecture as they cruise in sea and Space Yacht cruise in space.

He worked for the project of ISS NASA Freedom Space Station with Buzz(Edwin) Aldrin and then worked on SpaceHAB. After that he worked on the project from National Geographic for the Mars Documentary. Space World Japan, Mars World, Nukes on Mars, Drones, Rover, Mars Suits, Robots, Exoskeletons are some of his other works.



Space Tourism Conference (STC)
and Orbit Awards Dinner

April 28, 2021

20th Anniversary of Liftoff of the First Private Space Traveler

25th Anniversary of the Founding of the Space Tourism Society

At the Proud Bird Meeting Facility next to LAX

Key Notes from Ms. Melodie Yashar's Presentation: Space Exploration Architecture: the Moon and Mars

Founder of SEArch+ and to conceive, investigate, and produce innovation 'human-centered' design which enable human beings to not only live, but thrive in space environments beyond Earth...

Some award winning habitation projects and 3D Printing were presented.



Some habitation projects and 3D Printings.

Key Notes from Dr Jack Stuster Presentation: Tasks, Skills, and Abilities for the First Human Expeditions to Mars

Will you construct a building without knowing the purpose why you designed or built it?

If you cannot address the tasks, you will not be able to figure out what to design.

For joining AIAA:

<http://aiaa.org/membership> or <http://aiaa.org/join> There is a Student Membership and you might get a discount. And there is a 1-year free trial e-membership before paying for the Professional membership <http://aiaa.org/emember> Student membership is much lower rate, and you will get extra discount for student-transition-to-professional membership.

Some other links which has been shared on online gathering:

- <https://moon.nasa.gov/observe-the-moon-night/about/overview/>
- <https://www.worldspaceweek.org/>
- <https://space4women.unoosa.org/content/current-space4women-network-mentors>
- <https://engage.aiaa.org/losangeles-lasvegas/viewdocument/aiaa-la-lv-august-2020-newsletter>
- <http://events.r20.constantcontact.com/register/event?llr=p9tbt6cab&oeidk=a07eh4os7fs2d84684a>
- <https://www.techne-architects.com/>
- <https://moonvillageassociation.org/>
- <https://healthyworkplaces.berkeley.edu/>
- <https://simoc.space/about/>
- <https://spacegamesfederation.com/>
- <https://aiaa-lalv.org/events/>
- <https://www.aiaa.org/membership>
- <http://www.oasis-nss.org/wordpress/>
- <https://nonfiction.design/projects>



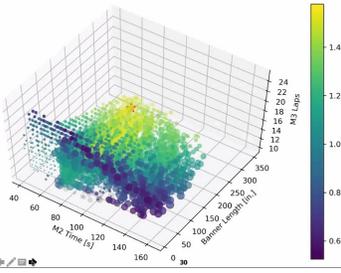
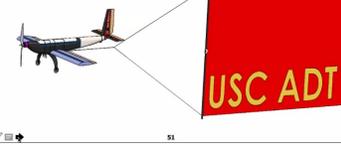
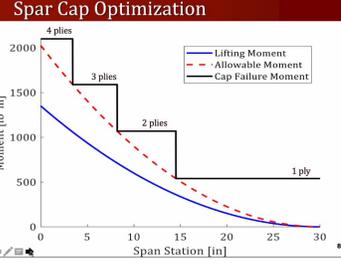
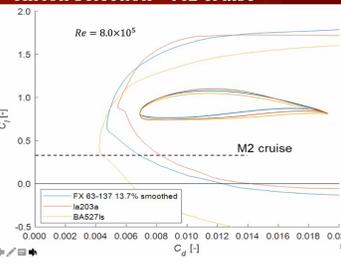
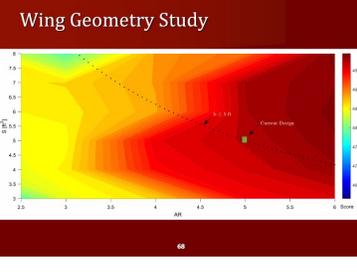
AIAA LA-LV e-Town Hall (19 September, 2020) (Screenshots Only) *(Continued from the Page 14)*

Part I: University Cubesat Work During the COVID-19 Pandemic with Prof. Scott Palo and his students

Part II: AeroDesign Team of USC: The 2019-2020 AIAA DBF 1st Place Winners

Part III: The Nuclear Thermal Propulsion Rocket (NTPR) @ UNLV (Valerie Lawdensky)

<https://aiaa-lalv.org/september-19-2020-cu-cubesat-during-covid-19-w-dr-palo-students-aerodesign-team-of-usc-aiaa-dbf-1st-winner-unlv-ntrp-valerie-lawdensky/>

 <p>Randi Arteaga Program Manager</p>	 <p>Drew Hudock Chief Engineer</p>	 <p>Colton Bullard Payloads Lead</p>	 <p>Erin Pugh Landing Gear Lead</p>
<p>2020 DBF Rules</p> <ul style="list-style-type: none"> Banner towing bush plane - 5 foot maximum wingspan 		<p>Banner In Flight</p> 	<p>Landing Gear Objectives</p> <ul style="list-style-type: none"> Track straight for up to 20 ft unloaded, ~100 ft loaded (M_2) Withstand 23 lbf landing loads up to 2.5 g Minimize weight and drag
 <p>Diana Salcedo-Pierce Structures Lead</p>	 <p>Jack Ahrens Aerodynamics, Stability & Control Lead</p>	 <p>Jackson Markow Performance Lead</p>	 <p>Mikell Myers Propulsion Lead</p>
<p>Spar Cap Optimization</p> 	<p>Airfoil Selection - M2 cruise</p> 	<p>Wing Geometry Study</p> 	<p>Constraints</p> <ul style="list-style-type: none"> M_2 <ul style="list-style-type: none"> Speed mission, 3 laps Fully loaded with passengers M_3 <ul style="list-style-type: none"> 10 min flight window 20 ft TOFL Tow banner (~ 6.3 lb drag) <ul style="list-style-type: none"> Takeoff with banner stowed

(Continued on the Next Page)

AIAA LA-LV e-Town Hall (19 September, 2020) (Screenshots Only) (Continued from the Previous Page)

Part I: University Cubesat Work During the COVID-19 Pandemic with Prof. Scott Palo and his students

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ANATOMY OF AN NTPR

The left diagram is a flow cycle diagram showing the path of propellant from the LH2 tank through pumps, valves, and the reactor core to the nozzle. The right diagram is a cutaway of a NERVA-derived SNRE, showing components like the internal shield, control drum, nozzle, nozzle skirt extension, turbopumps, external disc shield, reflector, reactor core, and propellant line.

NERVA-Derived SNRE Cutaway [8]

NTPR Flow Cycle Diagram for NERVA and Cermet Reactors [8]

MODELING THE MODEL

- MCNP is being used to analyze the nuclear performance of the reactor
- SNRE, Axial-Growth Engine
 - 564 Fuel Elements, 241 Tie-Tubes
 - 132cm long, 59cm engine diameter
 - 25.1klbf thrust
 - 906s specific impulse
 - 3.49 Thrust-to-weight ratio
 - 0.25g/cm³ uranium loading, 93% enriched
- Bimodal Option
 - 241 heat pipe elements to replace Tie-Tubes
 - Light isotope-enriched molybdenum shell
 - Lithium-7 working fluid
 - 0.1cm thick, 46cm long ZrH moderating sleeve

Segment – MCNP Model of NERVA-Derived, 25klbf, Axial-Growth SNRE [12]

FUEL ELEMENTS

The left diagram shows a fuel element cross-section with labels for Hydrogen Cooling Passage, ZrC Coating, Inlet Tie Tube, ZrH Moderator, Hydrogen Return Passage, Graphite Filter, and Outer Tie Tube. The right diagram shows a support element (tie-tube) cutaway with labels for Graphite sleeve, Tube (Inconel), ZrH moderator, Pyrolytic graphite thermal insulation, and External surface coated with ZrC.

Fuel Element and Support Element (Tie-Tube) Cutaways [4]

Fuel Element and Tie-Tube Cross-Section [8]



Valerie Lawdensky (Soon to become Dr. Valerie Lawdensky)

Gallery 1/2 – Michelle Evans



Moon and Jupiter on September 25, 2020. (Please enlarge the photo to see Jupiter at left in the photo.) The camera is a Nikon D5600 with a 300mm lens at f6.2. The photo is a composite overlay of two images. The Moon was exposed at 1/1000 and Jupiter at 1/60th. (Credit and Courtesy of Michelle Evans, AIAA Distinguished Lecturer, AIAA Member)



The Sun during the middle of the day a couple weeks ago during the worst of the smoke and ash. (Credit and Courtesy of Michelle Evans)

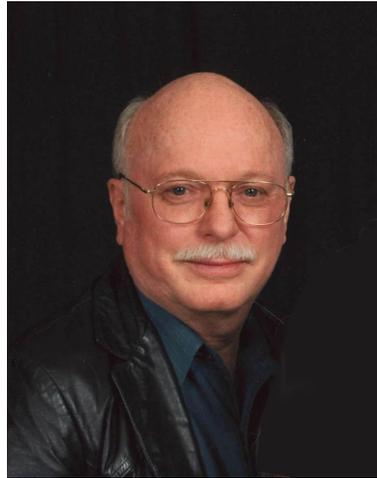


A new squirrel friend wandering around allowing this photo taken. (Credit and Courtesy of Michelle Evans)

Gallery 2/2– Michelle Evans



Moon and Mars on October 3, 2020. (Please enlarge the photo to see Mars at the top in the photo.) The camera is a Nikon D5600 with a 300mm lens at f6.2. The photo is a composite overlay of two images. The Moon was exposed at 1/1000 and Mars at 1/60th. (Credit and Courtesy of Michelle Evans)

AIAA Member Spotlight Summary (16 September – 19 October)(21 Sept., 2020)**Dr. Henry B. Garrett***AIAA Fellow***Principal Scientist****OFFICE OF SAFETY AND MISSION SUCCESS****Jet Propulsion Laboratory**

Dr. Garrett has a doctorate in Space Physics and Astronomy. He has over 150 publications on the space environment and its effects with specific emphasis in the areas of atmospheric physics, the low earth ionosphere, radiation, micrometeoroids, space plasma environments, and effects on materials and systems in space. While on active duty in the Air Force he served as Project Scientist for the highly successful SCATHA program which studied the effects of charging on spacecraft. For this he was awarded the Harold Brown Award, the Air Force's highest scientific award. In 1992, he was selected for a joint DoD/NASA assignment at the Pentagon as part of the Ballistic Missile Defense Organization where he acted as the Deputy Program Manager for the Clementine Lunar Mission and Program Manager for the Clementine InterStage Adapter Satellite (ISAS). For contributions to these missions, he was awarded NASA's Medal for Exceptional Engineering Achievement. After a 30 years career in the USAF Reserves, he retired in 2002 as a full Colonel and was awarded the AF Legion of Merit. During his 40 year career at JPL, he has been responsible for defining the space environment and its effects on reliability for many NASA missions. He has also published several textbooks on the space environment and its impact on spacecraft design and reliability. Dr. Garrett is an international consultant on the terrestrial and interplanetary space environments and spacecraft reliability having worked for INTELSAT, L'Garde, NASDA, LORAL, CNES, and other organizations. In 2006 Dr. Garrett received NASA's Exceptional Service Medal for "his achievements in advancing the understanding of space environments and effects." Recently, Dr. Garrett co-authored with Mr. Albert Whittlesey the primary NASA standard on spacecraft surface and internal charging for earth missions. Dr. Garrett retired from full time duties at JPL in 2017 but continues in an emeritus position. He was made a Fellow of the AIAA in 2019.

"I started my "career" in astronomy in 8th grade by grinding a 6 inch telescope and learning astrophotography for the state science fair. Each year after that I worked on my project ultimately making a complex reflector/refractor telescope camera that won me a first place in physics and the top award in optics at the 1966 International Science Fair in Dallas, TX. This allowed me to get into Rice University where I became the first undergraduate in their astronomy department based on my project. Ultimately I received my PHD and went on to a career in space physics and astronomy. Years later my high school science project came to the attention of my managers at NASA and I was made the chief optical inspector for the Hubble repair project (HARP)—you never know where your STEM activities will take you: from my youth in my backyard in Roswell, NM, to the planets and beyond!! (PS: Working at JPL has allowed me to "phone home"."

AIAA Member Spotlight Summary (16 September – 19 October)(28 Sept., 2020)

Michelle Evans **AIAA Distinguished Lecturer** **AIAA Member**

Founder and President, Mach 25 Media
(www.Mach25Media.com)
Writer, Photographer, and Communications
Specialist in aerospace



Michelle Evans in an F-104. (Courtesy of Michelle Evans)

Michelle Evans is the founder and president of Mach 25 Media (www.Mach25Media.com) and is a writer, photographer, and communications specialist in aerospace. She has written the bestselling book *"The X-15 Rocket Plane, Flying the First Wings into Space"* which was published by the University of Nebraska Press as part of their *"Outward Odyssey, People's History of Spaceflight"* series.

Michelle's background in aerospace engineering includes serving in the US Air Force working on missile systems, and later in private industry accomplishing environmental testing for systems used in airliners and spacecraft. Her current work with Mach 25 Media provides education and display services for astronaut appearances and other space-related events at government facilities, science centers, schools, and other venues across the country and overseas.

Michelle was elected as the President of the Orange County Space Society for 14 years, overseeing the group's activities on science, exploration, and technology outreach throughout California, across the United States, as well as overseas in Izmir, Turkey. Working with Global Friendship Through Space Education, she helped partner school children in the United States with those in Turkey and other countries for programs at Space Camp Turkey. In conjunction with her work there, she also led a tour group to witness the total solar eclipse from Manavgat, Turkey, on the Mediterranean coast.

Locally, she has worked extensively with, and has provided permanent exhibit artifacts for the Tessmann Planetarium at Santa Ana College.

Michelle is a Distinguished Lecturer with the American Institute of Aeronautics and Astronautics, and her book on the X-15 was a finalist for the Eugene M. Emme Award for Astronautical Literature. Michelle received the Diverse Community Leader Award from Orange County Human Relations, and was recognized as number 3 on the Orange County Register's list of the 100 Most Influential People in Orange County. She has appeared in numerous publications, including *Air & Space Smithsonian*, *Ad Astra*, *Orange County Register*, *Los Angeles Times*, and the *New York Times*. Michelle had a feature story about her life in *Time* magazine. She was a technical consultant on the Neil Armstrong biopic "First Man," and has consulted with National Geographic television.

On transgender issues Michelle is the founder of the TG Rainbow support group which has operated in Tustin for the past 10 years. She is also the Transgender Coordinator for the PFLAG Speakers Bureau for Orange County and Long Beach, and has spoken to high schools, colleges, universities, civic groups, private companies, governmental agencies, and the Orange County Sheriff's Academy nearly 300 times over the past 13 years. She and her wife Cherie, have been vocal advocates for trans rights, specifically in the fight for marriage equality that raged for more than a decade before finally being settled in favor of all LGBTQ people by the Supreme Court. Michelle has also been instrumental in the education of medical insurance companies when it comes to the needs and rights of transgender patients.

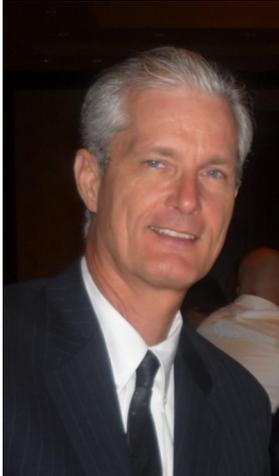


Michelle Evans with X-15 pilot and astronaut Joe Engle. (Courtesy of Michelle Evans)

AIAA Member Spotlight Summary (16 September – 19 October)(5 Oct., 2020)

Douglas Yazell AIAA Associate Fellow

Honeywell-Retired;
Teacher, Math & Robotics, Texas City High School



Mr. Yazell worked for Honeywell aerospace engineering from 1981 to 2011, mostly on NASA projects. He earned a BSEE degree from the University of South Florida in Tampa and a Master of Science in Engineering from the University of California, Irvine, south of the Los Angeles area. The latter was mostly from the mechanical engineering department, with work in robotics, control systems, and equations of motion. He worked in Clearwater Florida 1981-1983, the Los Angeles area 1983-1992, and in the NASA/JSC community after 1992. Since 2016 he is a Teacher in public high schools with two teaching certificates, Math and Technology Education, including a year of teaching Robotics.

Mr. Yazell worked as a newspaper carrier and city recreation center leader, among other jobs, before starting to study electrical engineering at the University of South Florida in Tampa. He was leaving the small city of St. Petersburg on the other side of Tampa Bay where he lived with his parents and an older brother since starting high school there in 10th grade 14 years earlier. His good reputation with the city recreation center work led to a student intern job with Honeywell in Clearwater Florida with the space shuttle entry flight control team. Upon graduation (BSEE), he represented Honeywell at the historic Rockwell International site in Downey California in the Los Angeles area. Five years later he continued to represent Honeywell at the McDonnell Douglas site in Huntington Beach, California. A brand new 8-story building was the site for the McDonnell Douglas Space Station Freedom team. As for becoming an AIAA Associate Fellow,

he volunteered to be of service to the profession in various roles starting in 1998 in AIAA Houston Section in the NASA/JSC community. As for becoming a member of the Aerospace America editorial board for about 8 years with Editors Elaine Camhi and Ben Ionnatta, he was recommended by an AIAA leader because of his work as Editor of Horizons, the newsletter of AIAA Houston Section. The prior Editor, Jon Berndt, did an amazing job with thousands of downloads per issue (sometimes tens of thousands). Mr. Yazell enjoyed keeping up that tradition from 2011 to 2014, including the use of Microsoft Publisher (for layout editing), and later, Adobe InDesign. Mr. Yazell added climate change science, engineering, and public policy to Horizons since 2013 once PBS called it to his attention with the October 23, 2012 episode, Climate of Doubt. After seeing that hour of investigative journalism, the subject was on his radar for the first time, and he knew he could trust NASA, NOAA, national science academies, scientific professional societies, and the reports of the United Nations Intergovernmental Panel on Climate Change (IPCC). In 2014, Ian Haney-López convinced Mr. Yazell that race was the most important problem in the USA, as Professor Haney-López was doing a book publicity tour for this 2014 book, "Dog Whistle Politics." The author was a guest on the PBS show Moyers & Company. Mr. Yazell is now a member of the AIAA Diversity & Inclusion Working Group (DWG), led by Jandria Alexander. As for co-founding the since-2007 France-USA sister sections with AIAA Houston Section and 3AF-MP (www.3af-mp.fr), a Chinese sister section in Shanghai was popular with AIAA Houston Section since 1987. Its founder asked Mr. Yazell to continue that tradition, but Mr. Yazell lived in France aged 4-6 (1957-1959), studied French in high school, and married a French woman in 1985, so Mr. Yazell suggested that French tradition starting in 2004.

As for writing the successful nomination report for one of the AIAA Historic Aerospace Sites, the 1940 Air Terminal Museum near the "right field" runways in Hobby Airport is a gem. The late airline Captain AJ High probably wrote most of that information for the museum website (<https://www.1940airterminal.org/>). The air terminal building was created using the "Art Deco" style. Ironically, the day of the award ceremony, when AIAA awarded the large bronze plaque to the museum, a rainstorm caused flash flooding all day long, and human-induced climate change makes every rainfall worse when air is warmer. Coincidentally, the museum work led Mr. Yazell to learn that the first aviator in Texas was French pilot Louis Paulhan, who performed in a 1910 Texas airshow.

AIAA Member Spotlight Summary (16 September – 19 October)(12 Oct., 2020)

André Bormanis AIAA Member

*Writer, consultant, and television producer, currently serving as a writer and co-executive producer of the Fox / Hulu television series, *The Orville*.

*Writer and consulting producer on the latest season of the Fox / National Geographic television series *Cosmos*, based on the award-winning PBS series created by Carl Sagan and Ann Druyan.

*Head writer and co-executive producer of the *Mars documentary / drama series* for the National Geographic channel.

*Star Trek science consult

*Writer / producer on the *Star Trek: Enterprise series*

*Writer and consultant for the Disney XD animated series *Tron: Uprising*



André Bormanis standing next to the big alien "Unk," on the set of The Orville, from an early season 2 episode. (Courtesy of André Bormanis)

Mr. Bormanis is a writer, consultant, and television producer, currently serving as a writer and co-executive producer of the Fox / Hulu television series, *The Orville*. He was also a writer and consulting producer on the latest season of the Fox / National Geographic television series *Cosmos*, based on the award-winning PBS series created by Carl Sagan and Ann Druyan. In 2016 he was the head writer and co-executive producer of the *Mars documentary / drama series* for the National Geographic channel.

In 2010 and 2011, he worked as a writer and consultant for the Disney XD animated series *Tron: Uprising*, based on the feature film *Tron: Legacy*. In 2009, he was a writer and supervising producer for the ABC Studios series *Legend of the Seeker*. The previous year, he was a writer and producer on the CBS / Warner Brothers television series *Eleventh Hour*, and in

2005, for the CBS / Paramount television series *Threshold*. Prior to *Threshold*, he was a writer / producer for the *Star Trek: Enterprise* television series, and science consultant for *Star Trek: Voyager*, *Star Trek: Deep Space Nine*, and the *Star Trek: The Next Generation* feature film series. He has written stories and teleplays for both *Star Trek: Enterprise* and *Star Trek: Voyager*, is the author of a book, *Star Trek Science Logs*, published by Pocket Books in February 1998, and is a contributor to another book, *New Worlds, New Civilizations*, also published by Pocket Books. He co-authored the narration for *Centered in the Universe*, a planetarium show currently running at Griffith Observatory in Los Angeles. He has written numerous magazine articles for popular science publications including *Sky & Telescope*, *Mercury*, *The Journal of Materials*, and *The Colorado Plateau Journal*, and is a frequent contributor to the online space policy forum *The Space Review*.

Mr. Bormanis received a B.S. in Physics from the University of Arizona, and an M.A. in Science, Technology, and Public Policy from the George Washington University. His master's thesis, directed by Dr. John Logsdon, was entitled *A Program in Transition: Policy Aspects of U.S. Planetary Exploration*.

Looking back, there were several key experiences in my childhood and early adulthood that paved the way to my career working at the intersection of art and science...

When I was seven years old, my family moved from Chicago, IL, to Phoenix, AZ. It was 1966. From the back yard of our house in those days, you could still see the Milky Way on a clear summer night. My father told me that the Milky Way was made of stars that were too far away to see as individual points of light. I was astonished by this. I checked out a book from the school library and started to learn more about astronomy. This was also the time of the Moon Race, and my father, through his work at the Motorola Government Electronics Division in Scottsdale, had some involvement in the Apollo program.



AIAA Member Spotlight Summary (16 September – 19 October)(12 Oct., 2020)

André Bormanis

As a child, my favorite toy was Lego. It's about the only thing I ever played with. Fueled by my interest in the space program, I started building spaceships out of Lego, creating ever more elaborate models as I got older. There were no Lego spaceship kits in those days, so I used pieces from house and Big Rig Truck models to build ships that featured airlocks, viewports, crew quarters, legs that folded out for landing on alien planets, and other features I learned about from science fiction television shows (mostly *Lost in Space* in those days). I took a piece of black cardboard and punched tiny holes in it with needles, then put a lamp behind the cardboard to create a starfield my miniature astronauts could see through their viewports. The astronauts themselves were inch-tall plastic figurines of characters from some of the cartoon shows I watched. I wrapped their bodies in aluminum foil and their heads in Saran wrap so they could go on EVAs. I converted bare patches of dirt in our backyard into alien planet landscapes, using ripped up sponges I spray-painted gray to make giant (at that scale) igneous boulders. I scattered colorful minerals and crystals around and added lichen and other foliage from model train sets to fill out my miniature landscapes.

When I was eleven years old I joined the Boy Scouts. One of our first summer camping trips was to Oak Creek Canyon, near Sedona, AZ. I knew I'd be able to see the Milky Way better from such a remote location, and sure enough, it glowed like a solid white band of light from horizon to horizon. I was amazed at the sight of it, and the sheer number of stars I could see with my eyes.

Coming home from that trip, I was determined to get a telescope. I looked in the Yellow Pages under "telescopes" and the first company listed was called Ad Astra. I called the number and asked the man who answered the phone -- a brilliant optician named Max Bray -- if he made reflectors or refractors. He said that he made telescopes that were a combination of both. I had never heard of anything like that! My dad drove me to Mr. Bray's shop in downtown Phoenix a few nights later, where he set up a three-inch Maksutov Cassegrain telescope he'd made and pointed it at Saturn. The image of its small yellow disk encircled by a white ring literally took my breath away. I was hooked on astronomy and space science for life (and Max Bray and his son Wade, an acoustical engineer, became lifelong friends).

By the time I was in High School, I was also hooked on science fiction (particularly the "space opera" subgenre), the original Star Trek, and Carl Sagan. These three influences

greatly encouraged my growing interest in writing and storytelling.

I majored in physics at the University of Arizona. One of my professors, Dr. Donald Huffman, was impressed with a report I had written for my senior year experimental physics lab. He told me there weren't a lot of scientists who were also good writers, and he encouraged me to consider getting involved in technical writing. A short time later I was writing articles for popular science magazines, like *Sky & Telescope*, and eventually I worked up the nerve to take a screenwriting class at Arizona State. My teacher, an accomplished novelist and screenwriter named Stephen Geller, liked my work, which gave me more confidence to explore creative writing. I had already written a Star Trek spec script, and under Steve's guidance wrote a screen adaptation of a science fiction novel (*Fiasco*, by Stanislaw Lem).

In 1991 I was offered the chance to earn a master's degree in science, technology and public policy at The George Washington University under a NASA Space Grant Fellowship. It was an amazing opportunity and I loved learning about the interplay between NASA research and national science policy.

While I was at GWU, I also started shopping my scripts to agents in Hollywood, hoping to find one who could get me a meeting to pitch story ideas to the producers of Star Trek: The Next Generation, which was on TV at the time. After a number of rejections, I finally found an agent who was interested in representing me. She discovered that the Star Trek producers were looking for a new science consultant. They wanted someone with both a creative writing background and a science background, someone who understood the script writing process and knew the Star Trek series. To make a very long story short, they interviewed me, they liked me, and they hired me. And as luck would have it, they needed me to start literally to the week that my NASA Fellowship ended. And so in May, 1993, I moved from Washington DC to Los Angeles to be the new Star Trek science consultant.

Eventually I sold a few stories to the Star Trek: Voyager series, which premiered in 1995, and they soon asked me to write a full script. They liked that script well enough to ask me to write another one, and several more after that. Eventually I became a full-time writer / producer on the Star Trek: Enterprise series, and I've been writing for television ever since.

AIAA Member Spotlight Summary (16 September – 19 October)(19 Oct., 2020)

Al Globus

AIAA Member

AIAA Space Colonization Technical Committee

Contract software engineer, NASA Ames Research Center – Retired



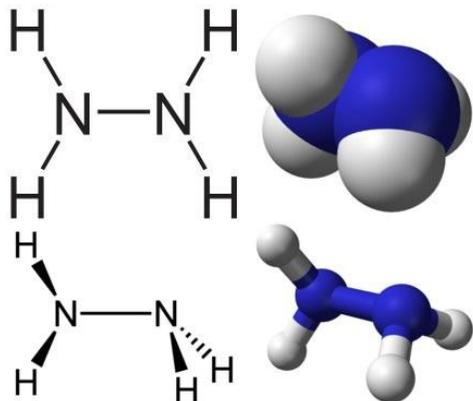
Al Globus worked at NASA Ames for 39 years as a contract software engineer on space settlement, asteroid mining, Hubble, space stations, X37, shuttle, Earth observation, TDRSS, cubesats, lunar teleoperation, spaceflight effects on bone, molecular nanotechnology, scientific visualization, and space solar power publishing dozens of papers on these and other topics. He founded and has run the annual NSS Space Settlement Contest for 7-12 grade students for over 25 years. The contest attracted 14,000 kids in 2020. Most recently, he found a way to build O’Neill-style space settlements with multiple orders of magnitude less mass and place them close to Earth, making launch from Earth practical.

Al is a member of the NSS Board of Directors, chairman of the Space Settlement Advocacy Committee, member of the Policy committee, and sits on the board of the Alliance for Space Development.

While earning his BA in Information Science at UC Santa Cruz, in 1978 Al’s housemate was hired to clean out someone’s garage. He brought home a stack of Co-Evolutionary Quarterly issues, including one on space settlement. It blew Al’s mind. He knew we just had to build these things. A few days later while he was raving to other students about space settlement a tall guy tapped him on the shoulder and asked “Would you like to work at NASA?” Al jumped on it, went to NASA Ames when he graduated, the tall guy got a \$500 bonus and became one of Al’s closest friend.

Volunteers are needed for all AIAA activities, please contact: cgsonwane@gmail.com

***Celebrating National Chemistry Week Events Organized by Southern California ACS, Co-organized by AIAA Los Angeles Las Vegas
October 19-24, 2020, (All Time PDT) ([Add to Calendar](#))***



National Chemistry Week Event

RSVP and Information: <https://conta.cc/35sRBhU>

1) Oct 19, 2020, Monday: 5-6 pm Talk

Dr. Ian S. Haworth, Associate Professor & Vice Chair, Department of Pharmacology & Pharmaceutical Sciences, School of Pharmacy, University of Southern California
"Chemistry in Drug Design and Delivery: Use of Chemical Principles to Make Better Drugs"

2) Oct 20, 2020, Tuesday 5-6 pm Talk

Dr. Krishna Kallury, Ph.D.

"Ingredients for Life – Chemistry of Healthy Foods"

3) Oct 21, 2020, Wednesday 5-6 pm Talk

Dorothy Pan, resident physician at Keck Hospital and LA County Hospital with the USC Caruso Department of Otolaryngology – Head and Neck Surgery, training to be a surgeon-scientist advancing therapies for and treating disorders of the ears, nose, and throat.

"Nanoparticle Drug Delivery: History and Future Developments"

4) Oct 22, 2020, Thursday 5-6 pm Talk

Professor G. K. Surya Prakash, Director of Loker Hydrocarbon Research, Institute and Chair of the Department of Chemistry at USC

5) Oct 23, 2020, Friday 5-6 pm Talk

Brenda Eap, Ph.D. Student, USC

"Ketone bodies in aging"

6) Oct 24, 2020, Saturday 10 am -11 am Talk

Jessica Weber, Ph.D., JPL Postdoctoral Fellow (3227), Origins and Habitability Lab

"Mineral organic interactions and prebiotic chemistry"

7) Oct 24, 2020, Saturday 11 am -12 pm Panel Discussion

"Women for Chemistry and STEM career"

A) Jessica Weber (JPL)

B) Maggie Fox (PhD student at UCLA)

C) Dorothy Pan (Keck Hospital and LA County Hospital)

D) Khushbu Patel (Relativity Space)

E) Brenda Eap (USC)

F) Dr. Kristeen Pareja-Navarro (Tracy Lab)

8) Oct 24, 2020, Saturday 12-1 pm Panel Discussion

YP young professionals for Chemistry and STEM Career

A) Ryan Casey (Chaminade College Preparatory)

B) Dr. Ian S. Haworth (USC)

Volunteers needed

9) Oct 24, 2020, Saturday 1-2 pm

Inspiring African American and Minorities to pursue STEM

Tyrone Jacobs Jr. (Northrop Grumman)

10) Oct 24, 2020, Saturday: 2-3 pm Talk

Daniella Duran

Honors Nanoscience and Chemistry Teacher- Valencia High School, Science Technology Engineering Math (STEM) Club Advisor, Teacher Facilitator/ PD provider- UCLA Nanoscience Program

STEM talk: Building partnerships, providing meaningful research experiences for students, and promoting diversity in STEM by leveraging technology and human resources

11) Oct 24, 2020, Saturday 3-4 pm Talk

Volunteers needed

Volunteers are needed for all AIAA activities, please contact: cgsonwane@gmail.com

Saturday, October 29, 2020, 6:30 – 8 AM PDT (Add to Calendar)

e-Happy Hour 10/29

**featuring André Bormanis and Science, Sci-Fi, Media
Networking with aerospace & media professionals, students and educators,
young and experienced !**



RSVP and Information: <https://conta.cc/34qLxEt>



Mr. Bormanis is a writer, consultant, and television producer, currently serving as a writer and co-executive producer of the Fox / Hulu television series, *The Orville*. He was also a writer and consulting producer on the latest season of the Fox / National Geographic television series *Cosmos*, based on the award-winning PBS series created by Carl Sagan and Ann Druyan. In 2016 he was the head writer and co-executive producer of the Mars documentary / drama series for the National Geographic channel. In 2010 and 2011, he worked as a writer and consultant for the Disney XD animated series *Tron: Uprising*, based on the feature film *Tron: Legacy*. In 2009, he was a writer and supervising producer for the ABC Studios series *Legend of the Seeker*. The previous year, he was a writer and producer on the CBS / Warner Brothers television series *Eleventh Hour*, and in 2005, for the CBS / Paramount television series *Threshold*. Prior to *Threshold*, he was a writer / producer for the *Star Trek: Enterprise* television series, and science consultant for *Star Trek: Voyager*, *Star Trek: Deep Space Nine*, and the *Star Trek: The Next Generation* feature film series. He has written stories and teleplays for both *Star Trek: Enterprise* and *Star Trek: Voyager*, is the author of a book, *Star Trek Science Logs*, published by Pocket Books in February 1998, and is a contributor to another book, *New Worlds, New Civilizations*, also published by Pocket Books. He co-authored the narration for *Centered in the Universe*, a planetarium show currently running at Griffith Observatory in Los Angeles. He has written numerous magazine articles for popular science publications including *Sky & Telescope*, *Mercury*, *The Journal of Materials*, and *The Colorado Plateau Journal*, and is a frequent contributor to the online space policy forum *The Space Review*.

Mr. Bormanis received a B.S. in Physics from the University of Arizona, and an M.A. in Science, Technology, and Public Policy from the George Washington University. His master's thesis, directed by Dr. John Logsdon, was entitled *A Program in Transition: Policy Aspects of U.S. Planetary Exploration*.

Questions about Events/Program: events.aiaalalv@gmail.com

Volunteers are needed for all AIAA activities, please contact: cgsonwane@gmail.com
Saturday, October 31, 2020, 10 AM PDT ([Add to Calendar](#))

AIAA LA LV Special Event **AIAA LA LV Celebrates the 20th Anniversary of the International Space Station**

with

authors from the Outward Odyssey series of spaceflight history books:
David Hitt (Moderator), Francis French, Emeline Paat-Dahlstrom, Jay Chladek
(ISS and Beyond: A Historical Perspective on Life in Space)

Larry A. Trager and Dr. Cheng-Yi Lu
Aerojet-Rocketdyne
(Aerojet-Rocketdyne Space Station Power Systems)

Mr. Liam Kennedy

Inventor of the ISS-Above

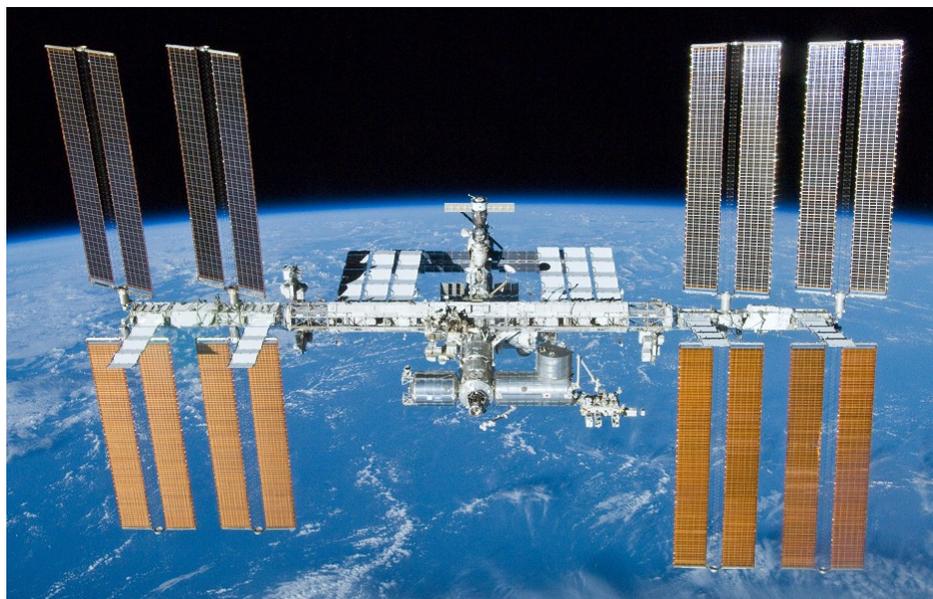
Former President, Orange County Astronomers

Former Griffith Observatory Planetarium Lecturer

Former NASA/JPL Solar System Ambassador

(ISS-Above, a Raspberry Pi gizmo that presents a rich set of live information about the ISS including live video views of the earth)

RSVP and Information: conta.cc/2O1AaGu



(More Speakers TBD)

Questions about Events/Program: events.aiaalv@gmail.com

Volunteers are needed for all AIAA activities, please contact: cgsonwane@gmail.com
Saturday, November 7, 2020, 10 AM PST (Add to Calendar)

AIAA LA-LV e-Town Hall Meeting 11/7

Perlan Project Glider Soars into History

with

Jim Payne

CHIEF PILOT | BOARD MEMBER

The Perlan Project

Test Pilot / Instructor, United States Air Force Academy - Retired

Consultant with NASA

Manager, Northrop's Global Hawk Program

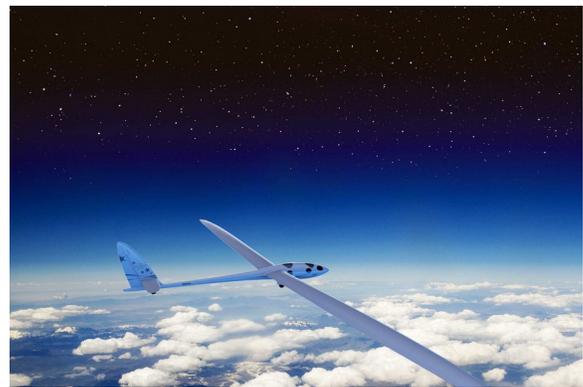
Test Pilot, Northrop's Firebird Program

Test Pilot of the Year - Kincheloe Award, SETP.

2019 Guinness Book of Records Aviation Page

Inspiration and Patriotism Award, Living Legends of Aviation (2018)

RSVP and Information: <https://conta.cc/32Eu100>



SURFING IN THE SKY

Glider pilots have surfed on mountain waves since 1932. The process is like surfing on a wave in the ocean, except the glider is in the wave rather than on the surface of the wave. Einar Enevoldson, a NASA Test Pilot, saw evidence that in regions closer to the Poles, in winter, the waves could extend above the troposphere and well into the stratosphere. Previously, no one had searched for waves in the stratosphere in sub-polar regions in winter. From 1992 until 1998 he gathered more evidence that these waves existed, and might be strong enough to lift a sailplane to remarkable altitudes. In 1998 Dr. Elizabeth Austin joined Einar in the search for an understanding of stratospheric mountain waves. She found that the Polar Vortex, and one of its principal components, the stratospheric polar night jet, existing only in winter, provided the high speed wind in the stratosphere that powered incredibly high waves. The Perlan Project was formed to explore these waves and soar them to the edge of space.

Jim Payne started soaring at the Air Force Academy in 1971. At the Academy he made his first wave flight and was immediately hooked. His paper for his senior technical writing course was "A Report on High Altitude Sailplane Flight." He graduated Outstanding Cadet in Soaring in 1974. He flew the F-4, F-5, F-16, F-16XL among other aircraft for the Air Force. Jim was the first pilot selected to pioneer the Air Force Institute of Technology master's with a follow-on assignment to AF Test Pilot School. He turned down a full ride to Stanford since it was not coupled with TPS. In 1983 Jim earned his Gold and Diamond Altitude legs in a SGS 1-26 in the Tehachapi wave. When he was assigned to the staff at the US Air Force Test Pilot School he was part of the Soar Eagle Project. The team equipped a Grob 103 with a pressure suit system. Soaring in this sailplane Jim earned a Triple Lennie Pin for a flight to 42,200 feet. With the advent of GPS flight recorders, Jim pioneered wave speed records.

Volunteers are needed for all AIAA activities, please contact: cgsonwane@gmail.com

Saturday, November 14, 2020, 10 AM PST (Add to Calendar)

AIAA LA-LV e-Town Hall Meeting 11/14

43rd Anniversary of the Voyagers 1 & 2

Voyager 1 & 2: Humanity's Most Distant Explorers

with Special Notes on Uranus and Neptune

by

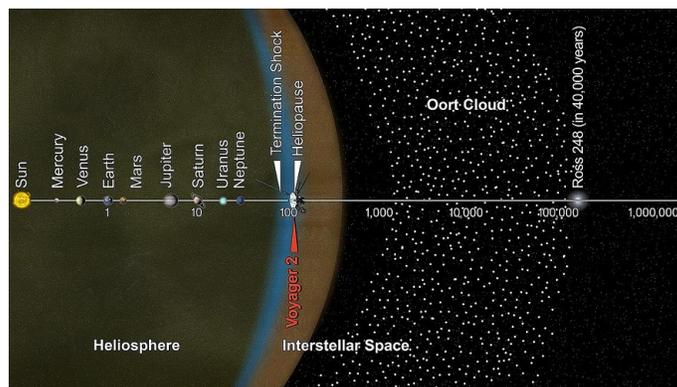
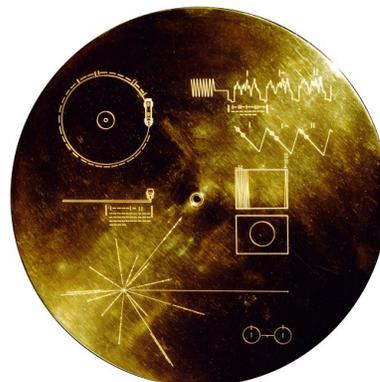
Todd Barber

AIAA Distinguished Lecturer

Senior Propulsion Engineer

NASA Jet Propulsion Laboratory

RSVP and Information: conta.cc/2OkJqe0



(More Speakers TBD)

Questions about Events/Program: events.aiaalav@gmail.com



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engage.aiaa.org/losangeles-lasvegas

Volunteers are needed for all AIAA activities, please contact: cgsonwane@gmail.com

Saturday, November 21, 2020, 10 AM PST (Add to Calendar)

AIAA LA-LV e-Town Hall Meeting 11/21 **Interstellar Flight Environments and Effects**

by

Dr. Henry B. Garrett

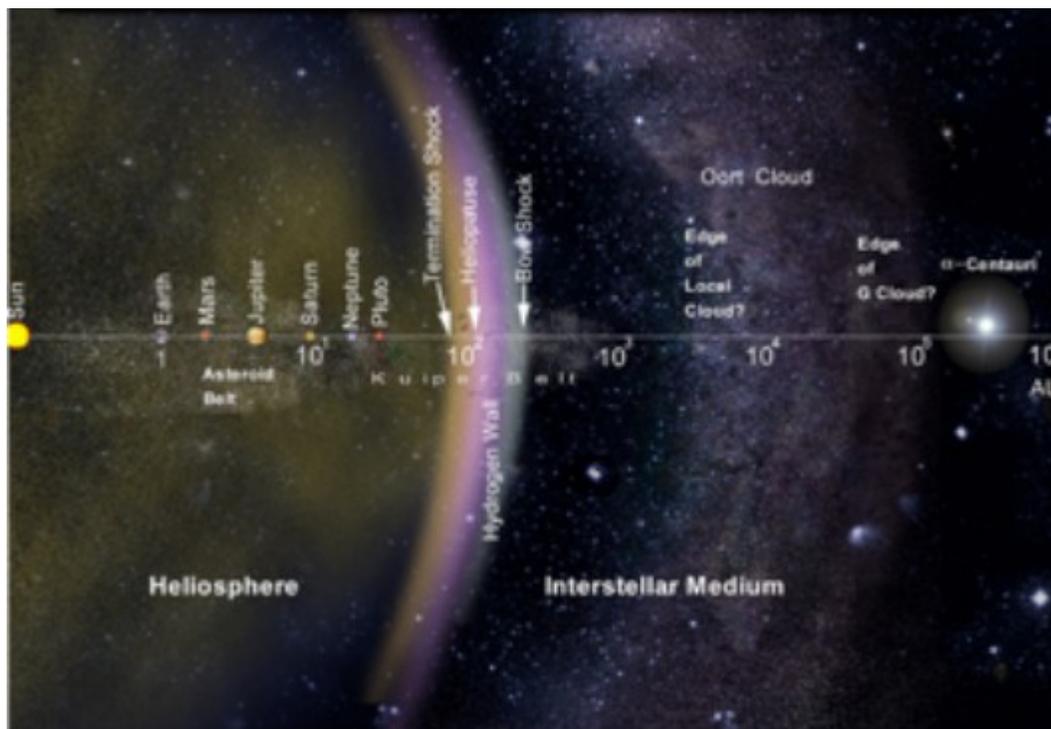
AIAA Fellow

Principal Scientist

OFFICE OF SAFETY AND MISSION SUCCESS

Jet Propulsion Laboratory

RSVP and Information: <https://conta.cc/3kLO8iR>



(More Speakers TBD)

Questions about Events/Program: events.aiaalav@gmail.com

Volunteers are needed for all AIAA activities, please contact: cgsonwane@gmail.com

Saturday, December 12, 2020, 10 AM PST (Add to Calendar)

AIAA LA-LV e-Town Hall Meeting 12/12

Space Settlement: an Easier Way

by

Al Globus

Contract software engineer, NASA Ames Research Center - Retired
AIAA Space Colonization Technical Committee
NSS Board of Directors



Exploring Solar System / Mars through Low-Latency Telepresence (LLT)

by

Daniel R. Adamo

Independent Aerodynamics Consultant, NASA JSC - Retired
AIAA Distinguished Lecturer
AIAA Associate Fellow



RSVP and Information: <https://conta.cc/3d9wDGD>

Questions about Events/Program: events.aiaalalv@gmail.com

See what's happening on our social sites: Please join us, take a look, and invite others!volunteers are needed for social media, please contact cgsonwane@gmail.com

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